THIRTIETH ANNUAL REPORT

OF THE

SECRETARY

OF THE

Massachusetts Board of Agriculture,

WITH

RETURNS OF THE FINANCES OF THE AGRICULTURAL SOCIETIES,

FOR

1882.

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STATE BOARD OF AGRICULTURE, 1883.

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Worcester South,	JOHN O. McKINSTRY of Southbridge,	1886
Worcester South-East,	VELOROUS TAFT of West Upton,	1885
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THE

THIRTIETH ANNUAL REPORT

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SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The Thirtieth Annual Report of the Board of Agriculture is respectfully submitted. The year under review has not been one of prosperity to the farmers of the Commonwealth. While agriculture has been very productive over the greater part of the country, and the Western crops of cereals have been enormous, we have suffered from meteorological conditions that have affected every branch of our husbandry unfavorably.

A stormy winter, with cold continuing far into the spring, delayed planting until late; or, where early work was attempted, replanting was necessary. A cold, wet June, though bad for tillage, made an excellent crop of grass. The rains ceased in June, followed by hot weather in which a great crop of hay was well harvested; from this time a drouth followed, equal in severity to any on record; fields, gardens and pastures were dried up, the crops of potatoes and roots were scant though good in quality, aftermath was an entire failure, and corn over a wide area was cut and fed green to the cattle to help out the dried pastures. The milk producers had great difficulty in keeping up their supply.

In regular rotation this should have been our apple year, but the crop was light, though fair in quality and remunerative in price.

The commonly expressed opinion that the drouth was unprecedented in severity is not correct, nor could it be attributed to especial cause.

The earliest settlers of Massachusetts found a climate very different from that where they had acquired their agricultural experience and precepts; irregular and fitful rainfall was found to be a characteristic of this climate.

The thermometer, a simple and necessary instrument of the present day, was not made practicable until the beginning of the eighteenth century, so that we have no record of the heat experienced in the summers of the first century of settlements upon this coast, but it is recorded that drouth was an ever-present menace to the struggling colonists, who were dependent upon the agriculture of a narrow area for their entire subsistence. In time of failure of crop, their only hope was in rescue from beyond seas.

A partial drouth in 1623 — no rain falling from the latter part of May until the middle of July — threatened the existence of the Plymouth Colony. In 1639, an early drouth threw the Colony into great alarm, and there was a resort to fasting and prayer. The years 1644, 1647, and 1648 were years of drouth, and the records of the Colony for a century succeeding show a continual recurrence at irregular intervals of seasons like the summer just passed.

There were also seasons of extreme wet and cold, like that of 1632, causing "great store of musquitoes and rattlesnakes," grasshopper and canker-worm plagues, and "millions of devouring worms in armies." Great variations were noticed in the winters, and it is probable that our climate is no worse than our fathers found it in their early experiiences.

The cultivation of corn was the important husbandry of savage life. Indian corn is a tropical plant; its origin was in the genial climate of Central America. It can only germinate when the moist ground is thoroughly warmed by the sun; its tropical habit demands a short, hot season. In the fervid heat, it uncurls its graceful leaves, rears its towering

blossom, spins its fertilizing silk, and perfects its golden grain, a miracle of beautiful and rich vegetation.

The Indians cultivated the lands upon the coast and upon the banks of rivers, fertilizing the soil with fish that were put into the hills in which they planted their corn. The settlers noted that the well-enriched corn-fields were not only more productive, but they better withstood the drouth. This lesson was little heeded by our ancestors, who upon all our soils exhausted the fertility in the reckless manner characteristic of all American agriculture. The lesson has been repeated to us this year with fresh illustration. Lands in a high state of fertility made fair crops, while neglected fields parched under the scorching sun.

Reference to the reports of the State Board since 1853, will show that drouth during some part of the season is the rule rather than the exception, and our husbandry, to be successful, must conform to this condition of our climate. Our most important crop is hay. Our fields are natural grass-lands, and the crop is produced and harvested with less labor than any other crop we make. The value of our hay in the last year of the State census, was $9,106,159, and this was of so-called English hay, not reckoning in the amount clover hay, salt hay, and meadow hay. This crop is gathered from far too great an acreage, and the whole amount could be more profitably and safely raised upon one-third of the land now employed.

No crop is so much affected by drouth as grass. Early drouth decreases the first crop, midsummer drouth cuts off the aftermath, and late drouth affects the fall growth which is a necessary protection against our frequent bare and open winters.

Concentration of labor, manure and seed upon one-third of the land now in mowing, would produce a greater crop, and drouths would not be so injurious. It is a rule that admits of no dispute, that well-manured lands best withstand drouth.

When the situation will admit, irrigation may be used to great advantage. Water can be supplied by wind-mills for the irrigation of market-gardens.

The season was healthy and our cattle have been free from

epidemic diseases. The fairs of the county societies were unusually successful; the exhibitions were good and the attendance was large; the financial condition of the societies has been improved with a few exceptions. A large number of institutes have been held, that have been attended by the secretary and members of the Board.

The Massachusetts Society for the Promotion of Agriculture, that for nearly a century, under wise and generous guidance, has assisted the husbandry of the Commonwealth, has again done important, permanent service, by the importation of thirty-eight rams of the best English breeds, that have been distributed among our scanty flocks. There is, however, but little hope for our sheep interest while we are exposed to the unchecked ravages of dogs. One of the rams belonging to the Massachusetts Society, an animal that could not be replaced for $150, has been killed, with others of the flock, and in Franklin County, where this husbandry is most persistently attempted, the sheep killed in 1882 were valued at $1,250; the damage to the flocks and the discouragement to the shepherds are not expressed in this appraisal. The protection given to dogs by the laws of the Commonwealth, and the consequent ruin of sheep husbandry, impeaches our boasted enlightenment. Up to the present time we have appealed in vain to the law-making power. The Massachusetts Society has also imported five Norman-Percheron stallions, which are distributed about the State in convenient places, and may be used by farmers at a reasonable rate.

MEETING OF THE BOARD

AT AMHERST JUNE 20, 1882.

By order of the Executive Committee, the members of the Board met as overseers of the Agricultural College to attend the graduating exercises, also to choose two members of the Board of Control of the Experiment Station, as ordered by the Act, chapter 212, Laws and Resolves.

There were present Messrs. Buell, Damon, Farnsworth, Grinnell, Gaylord, Goodrich, Hadwen, Haskell, Hersey, Jewett, Lynde, Moore, Noble, Slade, Sessions, Taft, Varnum, Ware, Wheeler. The Board was called to order at the Amherst House by the Secretary, who stated the object of the meeting, and, in the absence of the Governor, requested the members to elect a chairman. Hon. J. S. Grinnell was elected chairman, and the Board proceeded to the election of two members from its own body to serve upon the Board of Control of the Experiment Station. These were separately chosen, and the balloting showed the election of J. R. Nichols of Haverhill, and Edmund Hersey of Hingham. The meeting was then dissolved.

COUNTRY MEETING.

The country meeting of the Board was held at the Town Hall, in Northampton, on Tuesday, Wednesday and Thursday, Dec. 5, 6 and 7, 1882. The first session began at two o'clock on Tuesday, Hon. HENRY C. HASKELL of Northampton calling the meeting to order. He said:—

Gentlemen of the State Board of Agriculture, and Brother Farmers, — It is with pleasure that we welcome you here in the old Connecticut Valley, the home of this old three-county society, which has within its borders seven younger sister societies. We embrace the three river counties. We have a soil that will produce anything that can be produced in New England. And, gentlemen, we are not only an agricultural region, but we are a manufacturing region, as we have within our borders some of the largest and best equipped manufactories in the United States.

But, gentlemen, I will leave this subject for abler tongues than mine, as we have with us, to-day, a gentleman who stands second to none as an educator, and who was the friend and adviser of our late martyred President—Paul A. Chadbourne, President of the Massachusetts Agricultural College.

ADDRESS OF WELCOME.

BY HON. PAUL A. CHADBOURNE.

Gentlemen of the Board of Agriculture:—Words of welcome to strangers should come from old residents. But while Massachusetts is one broad domain, it is one home for all her children, and the Board of Agriculture are entitled to a welcome on any spot within her borders. They have done for her what no other body of men have done—increased her productiveness when her soil had been robbed of its virgin strength; have beautified her homes, rendered the cultivation of the soil profitable and attractive, and their influence for good was never greater than to-day.

But, as you come together, you bring with you associations that cannot be forgotten. We remember the learned and genial Hitchcock, identified for so many years with Amherst College, identified even with the rocks of Massachusetts which he interpreted, and identified with the cause of agricultural education. In his exalted studies and position, he deemed it an honor to join himself with the great movement for the liberal education of the farmer. With him was associated another who still lives, the venerable Wilder, whose labors and successes with fruits and flowers render his name a household word with every lover of rural life. He walked hand in hand with Hitchcock in the pioneer work of placing agriculture and horticulture in this country on a scientific basis; and, best of all, in giving such opportunities for culture to the young farmers as should not only enable them to get a living from the soil, but should make life worth the having.

What shall we say of Agassiz, the greatest naturalist America has yet known, whose words and labors brought delight to our counsels, and were to us like the dews and rains upon thirsty fields? What of Loring, whose words were ever eloquent and

instructive, and of Flint, whose volumes are unsurpassed among the reports of kindred associations?

Time would fail us to recount the solid work that has been done from year to year by those who are gone, and by those now before me, whose praises will be spoken by other men in other days. But any body of men, that by their very gathering can awaken such associations of beneficent deeds, are certainly welcome to any spot in this old Commonwealth. And to no place can they come more fittingly than to this ancient town in the most fertile valley of the State. Two hundred and thirty years ago, Pynchon and Holyoke and Chapin fixed their eyes on this spot, as one to be desired for beauty of situation and fertility of soil. But for ages before the corn-fields and tobacco plantations of the Indians had given this valley the appearance of civilization, even while the home of savage tribes. The Indian women, with moose bone and clam-shell hoes, cultivated here large fields of corn, and renewed the fertility of the soil with fish from the river. And the Indian warrior, although generally too lazy or too proud to work, here raised his tobacco with his own hand, because the weed was too noble for a woman to use, or even to touch. No "brave," even, could smoke it until he had gained renown on the war-path. To-day, women help raise tobacco in this valley, and their children often smoke it before they can claim the name of men. It may rebuke our pride and urge us to a moral improvement, to be reminded that in some things we are behind the Indians who cultivated these valleys more than two hundred years ago, and sold this township for a hundred fathoms of wampum, and ten coats of doubtful value.

But contrast Northampton to-day with the Nonotuck of those times! It is renowned for the men who have lived here in the past—divines and jurists. Look at its multiplied manufactures of wood and iron, and silk and cotton—giving a true idea of a model New England town by its diversified industry. Look at its institutions where the dumb are taught to speak, the unfortunate are cared for and the fortunate are educated, where a woman's wealth has done its highest and noblest work for woman's education.

And here, too, you are welcomed by the old agricultural society of the three counties—one of the pioneers beginning in

1818, and continuing with unabated vigor, while its children have grown to full estate around it.

To all these associations of the past that cluster around this ancient town, and to all its present progress and culture, we welcome you. We welcome you to what such influences can do in stimulating and instructing you,—we welcome you for what you can do for this society and community, in arousing or intensifying an interest in all that relates to the cultivation of the soil, in all that beautifies this valley—beautiful in itself, indeed, as it was left when the waters had smoothed its glacier-torn rocks—and on all that lies at the foundation of our happy home life and our national wealth.

But why do I, a comparative stranger, stand here to speak these words, when there are those around me, whose ancestors' names can be found among those who saw the Indians yield these acres to the white man's power? First of all, I stand here by their invitation to speak in their name; and this honor has been granted me because I represent here to-day, that institution which is the fruit of seed planted in this soil long years ago—seed that has been cared for and nurtured by the men who have been connected with this Board of Agriculture.

The Massachusetts Agricultural College is the outcome and fruitage of the work that has been done by all these agencies. In them it has its roots—to it they must look for the richest and most abundant fruit they can yield. On my own ground, then, I welcome you all as friends and promoters of the Agricultural College, and ask your attention for the remaining time allotted me to the consideration of that institution. What is the true idea of the Agricultural College? What its work? What is it now able to accomplish? What must be done *for* it and *with* it, that it may accomplish the work for which it was founded?

The grant of land and land-scrip for founding agricultural colleges was made by the general government in 1862. The civil war had brought out with great clearness the elements of national strength,—varied production in agriculture and the mechanic arts, and a citizen soldiery well trained in the art of war. To secure all these in their greatest perfection was the aim of the bill for establishing "Industrial Colleges" in the various loyal States. Whatever mistakes may have been made

in the organization and management of these institutions, no fault can be charged home to the original bill. It was eminently a wise measure, and suggested an outline of organization and management that has not as yet been improved upon. Its significant words are as follows: "the endowment, support and maintenance of at least one college where the *leading object* shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are *related* to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the *liberal* and *practical* education of the industrial classes in the several pursuits and professions of life." No branch of learning peculiar to the old colleges was to be necessarily excluded; but the new colleges were to push on to the practical application of the sciences they taught, and they were to train all their students as defenders of their country against domestic rebellion or foreign invasion. In a word, they were to educate their students as *men* and as *American citizens*. The rank of the education given is "*liberal*," the term applied to the education given by the highest institutions then known. It was to be so broad as to fit men for the "several pursuits and professions of life." If we should criticise any part of the language it would be "industrial classes." In the European sense of the word, we have no "*classes*." We have men of various pursuits, but in the same family may be found farmer, minister, merchant, mechanic and governor, all of one class and on perfect equality, though representing the different pursuits of life. But as the words "industrial classes" are generally used, they simply indicate those who have chosen a certain pursuit in life, and not a social class.

The object of these colleges was to obliterate the supposed superiority of the so-called "learned professions," by securing a "liberal," that is, the highest education, for those who chose industrial pursuits, thus lifting agriculture and the mechanic arts from the plane of mere routine labor to the dignity of learned professions, founded upon scientific knowledge and allied to, or connected with, those branches of learning essential for a broad and generous culture of the whole man. Many who have attempted the management of these colleges, as well as many who have criticised them, have apparently overlooked the

broad and generous plan upon which they were founded. It is doubtful if they will ever accomplish the great work for which they were intended, until their original purpose is so fully and constantly recognized and carried out by judicious, painstaking work that the currents of education shall be once fairly turned toward these new channels. When once fairly turned, that they will continue to flow can no more be doubted than we can doubt the success of any natural process when not artificially obstructed. An education that "gives boys what they need to daily use when they become men" commends itself as rational and practical. All true education should aim at this. And this certainly is the idea that is embodied in the bill founding the Industrial Colleges of the several States. The provisions of this bill were accepted by Massachusetts. One-third of the funds received from the United States was given to the Institute of Technology in Boston, for the promotion of the mechanic arts, and two-thirds were devoted to founding a college at Amherst, for the special work of agriculture.

By the gift to the Institute of Technology, the Agricultural College has been freed from much labor in building up a Mechanical Department — a fact that has been lost sight of by some — and is left free to carry out the idea of a college making agriculture the leading idea, while it secures rigid training in military tactics, and provides such a range of studies in science, literature and philosophy, as shall, in the words of the bill, promote "*liberal education.*"

The college now has 383 acres of land for farm, gardens, nurseries, etc. It has college buildings, laboratory, botanic museum, plant-houses, gardens and nurseries, so that provision is made for teaching all the sciences that relate to the cultivation of the soil, and these sciences are practically applied to all the work of the farm, garden, vineyard and orchard. The Durfee plant house and propagating houses afford practical instruction the year round.

The course of study aims to do what the original bill declared should be done—give a practical knowledge of agriculture and horticulture, and at the same time so educate the *man* that the students from the Agricultural College shall not be mere artisans, having learned a trade or business and nothing more, but be liberally educated, so that, as farmers, they shall rank in

intellectual training with those who choose what have heretofore been called the "learned professions." It is plain that farming will never take its true place, nor farmers have that influence in the government of our land which they ought to have, until they take their place with those in other professions, not only as men of power and practical ability, but as men of learning and culture. Those who claim that the farmer's life forbids this result have never yet fully appreciated the farm as a place for study and thought, as well as a place for labor.

The course of study in the Massachusetts Agricultural College at the present time embraces the following topics:

1. *Lectures on Health and Habits of Study* and general plan of the college work. These lectures are now given by the president. The student, as he begins his college work, is instructed as to the best means of preserving health, the best methods of study and of recitation to secure knowledge and the best mental training at the same time. He has laid before him the studies of the whole course, so far as he then is able to understand them, that he may in the beginning have some just idea of the value of the different studies, may understand why they come in the order they do, and how they make a complete educational whole to secure the purpose for which the college exists.

2. *Botany*—structural and systematic—special application to cultivated plants—*Microscopy*.

3. *Zoology*—systematic, with special studies in *Entomology*.

4. *Agriculture* extending through the entire course of four years—study of soils—methods of working—Fertilizers—Draining—Farm Implements—Special Crops, etc., etc. *Stock* and *Dairy Farming*, with lectures on *Veterinary Science*.

Work on Farm under direction of Professor of Agriculture, six hours a week, when such work can be supplied.

5. *Horticulture.* Market Gardening—Arboriculture. Care of Nurseries—Landscape Gardening. Work in nurseries, propagating houses and vineyard done under direction of Professor of Horticulture.

6. *Chemistry.* Theoretical and practical. Work in Laboratory junior and senior years, under direction of the Professor of Chemistry.

7. *Geology and Mineralogy*, with special reference to Agriculture. The origin of Soils, location of Artesian wells, etc., etc.

8. *Military Science and Military Drill* continued through the whole course under direction of officers of the Regular Army, detailed by the United States government for this special service. This includes weekly inspection of all halls and rooms in college buildings, thus securing neatness and proper sanitary conditions. The students of the college, when graduated, are competent in their military knowledge to receive commissions in the regular army.

9. *Mathematics* — Algebra, Geometry, Trigonometry and its application, Mechanics, Physics and Astronomy.

10. *English Literature, History, Constitution of the United States, Elocution, Essay Writing and Debates, Book-keeping, Drawing.*

11. *Rural Law, Outlines of Mental and Moral Science.*

12. *French and German Languages.*

This is a brief outline of studies without any attempt at systematic arrangement, as they are given in a curriculum of terms. Other subjects are introduced as circumstances favor. To some of the subjects here named but little time can be given, and this varies with different classes; but to those studies, like botany, chemistry, agriculture and horticulture, which are the practical studies of the course, the time and strength of the student are specially given.

In addition to the college proper, the work of which henceforth will be mainly that of instruction, the State has now established an Experiment Station which will give to the student a constant acquaintance with the methods and results of agricultural experimenting under the direction of the most competent men the board of control can employ. The college can use to advantage larger funds than it has. In many directions increased funds are absolutely essential for carrying out the true idea of the college. But, on the other hand, it is apparent that the people of the State, as a whole, do not understand the facilities for a practical and liberal education here afforded. The committees that have come from the legislature have not failed to express their surprise at the extent and perfection of the educational machinery here in operation. When all the legislators and citizens understand the true state of the case, we

believe that the Massachusetts Agricultural College will never lack for students or the funds needful for carrying on this institution founded by the joint action of the United States and the Commonwealth of Massachusetts.

The CHAIRMAN. We have with us to-day as our first essayist, a young man born and nurtured in the Connecticut Valley, transplanted to the broad fields of the Old Dominion, and now working out the problems of the agriculturist on the Houghton Farm, Mountainville, N. Y., Major HENRY E. ALVORD.

THE MILK QUESTION.

BY HENRY E. ALFORD OF HOUGHTON FARM.

Notwithstanding the wonderful progress that has been made by agriculture, during the present century, the improvements in the implements and methods of cultivation, in live stock and its feeding, all matters of deep interest to be specially and ably presented later in this meeting, we find some of the soundest advice as to practical farming among writings of an early period in history.

The foundation principles of successful agriculture were understood centuries ago. Among the truths then recorded, there is none which we can more heartily endorse, than that of an ancient Roman farmer, who wrote, "Cattle are the foundation of all riches."

In our own time, the closest student of European and American agricultural economy is Sir John Lawes of Rothamsted, in Herefordshire, England. Although an eminent scientific man, he values science for what it does, not for what it is, and takes broad and practical views of all questions of farm management. Lately, writing for farmers of the older sections regarding their competition with those on new lands, he gave this opinion: — "The relation between grain and the various animal products is no longer what it was; while the price of the former has a continuous declining tendency, that of the latter continues to advance. There can be no reasonable doubt that profitable agriculture in the future will depend, more than it has ever done before, upon the successful management of farm stock."

Farmers in the older States are doing more and more every

year towards bringing up the productions of their well-worn acres. Better cultivation and increased fertility are the aims. And for increasing fertility, despite all the arguments for chemicals and compounds, and the importation of guanos and phosphates, the main reliance is and must ever be, that too often neglected and abused material, animal manure. Nothing equals good barn-yard manure in improving both the chemical and mechanical condition of the soil. To add to the manure made upon the farm is, therefore, a leading interest with every good farmer. To this end the live stock of the farm is increased. But although the main object in keeping domestic animals in New England is often the making of manure, the owner is hardly satisfied unless the stock makes other dividends in return for the expenditure upon it; and while there are those who still succeed, as of old, in this vicinity, in making beef and pork and mutton and wool at a profit, the great majority prefer to keep milking stock. The good milch cow makes daily a tangible and satisfactory return for her food and care, besides her office as a manure maker, and in these days, in this section, is of all farm animals the surest source of a double profit.

That this is not mere conjecture, but accepted truth, put in practice by those who know their own interests, is proven by the animal statistics of the Eastern States. I will quote only those of Massachusetts.

Massachusetts.	1840.	1850.	1860.	1870.	1875.	1878.	1880.
No. Milch Cows, .	121,102	130,099	144,492	145,801	149,765	159,139	174,859
No. other Cattle, .	161,472	149,895	136,422	104,281	98,224	-	101,616
Value Milch Cows, .	$2,422,040	$3,252,500	$4,190,268	$7,581,652	$7,188,720	$7,956,950	$8,742,950

The table shows the milch cows largely increasing in number, especially during the last few years, while "other cattle" have decreased. Massachusetts has fifty thousand more cows than in 1840, and sixty thousand less "other cattle." The improvement in the quality has also been constant, the average value of a cow has doubled in thirty years, and the total value of this class of stock increased from two and one-half million

dollars in 1840, to eight and three-fourths million dollars in 1880. The greater numbers and higher value both mean more milk.

The growth of our cities and manufacturing towns enlarges the demand for milk as food, and is another cause of the increased production of this article.

The tendency of the times is to lighten the burden of domestic manufactures, which include the making of butter and cheese on the farm, and to sell off all raw materials as fast as produced. This is a further cause for swelling the volume of milk thrown upon the market.

Rapid as the growing demand for milk has been, the increase in production has fully kept up with it, and for some time the supply has exceeded the demand. In many parts of the State, a surplus of milk is now to be found during parts of the year, if not most of the time, and the question arises, What is the best disposition to make of it?

The milk question thus presents itself as one of the interesting and important topics of the day, among the farmers of Massachusetts.

The consideration of this subject naturally divides itself into three parts, as follows:

1st. Shall the milk be sold?

2d. How shall it be sold?

3d. If not sold, what shall be done with it?

I. "Shall the Milk be Sold?"

This is a question which cannot be briefly answered, in the abstract. The reply must depend upon the various conditions which surround the farm as to which the inquiry is made.

On general principles it is safe to say, that it is poor policy to sell milk; that milk farming is poor farming, except under most guarded conditions. But many exceptions must at once be made to cover cases where all the circumstances are carefully considered, and the fundamental objections resolutely removed.

One great trouble is, that the steady cash income is so alluring as to often become deceptive. The credit side is pleasingly felt, while the debit side is not fully computed. When the interest on the cost of the cow is given, and the cost of her feed

and the returns from the milk sales, the story is but half told. The depreciation in the value of the cow herself, the time of men and horses, the wear and tear of wagons and harness, and the heavy losses on cans, besides incidentals of ice-cooling and so on, are too often overlooked or rated below their actual cost. Every one with any experience knows that the business of selling milk, whether wholesale or retail — entirely distinct from the actual cost of production — is one which involves constant expenditures which, however small singly, are so great in the aggregate as to materially reduce the margin of profit, if any accrues.

The most serious objection to selling milk, however, is the daily drafts made upon the fertility of the farm. These are small and imperceptible, but they are sure, and when examined by the year, become formidable. They show that constant production and sale of milk is, in effect, as year succeeds year, nothing more nor less than selling the farm itself, by the gallon or by the pound.

The better to appreciate this, let us consider of what the article milk is composed.

The following table is compiled from the writings of two eminent dairy chemists — Dr. Henry L. De Klenze of Munich, and Dr. Aug. Voelcker of London. The chemical constituents of milk, as thus exhibited, are the average results of a very large number of analyses.

For convenience of reference, two other tables are also here inserted.

Composition of 1,000 Pounds of Milk.

1,000 LBS. OF MILK.	160 LBS. OF CREAM.	Water,	121.0 lbs.	Water,	121.000 lbs.
		Fat,	29.5 "	Solid,	20.060 "
				Fluid,	8.850 "
				Volatile,	0.590 "
		Casein,	5.0 "	Carbon,	2.655 "
				Hydrogen,	0.353 "
				Nitrogen,	0.770 "
				Oxygen,	1.090 "
				Sulphur,	0.055 "
				Phosphorus,	0.077 "
		Albumen,	0.5 "	Carbon,	0.267 "
				Hydrogen,	0.035 "
				Nitrogen,	0.077 "
				Oxygen,	0.113 "
				Sulphur,	0.008 "
		Sugar,	3.5 "	Carbon,	1.400 "
				Hydrogen,	0.213 "
				Oxygen,	1.712 "
				Water,	0 175 "
		Ash,	0.5 "	Phos. Acid,	0.135 "
				Lime,	0.130 "
				Potash,	0.085 "
				Chlorine,	0.080 "
				Soda,	0.047 "
				Magnesia,	0 020 "
				Iron,	0.003 "
			160.0 lbs.		160.000 lbs.
	840 LBS. OF SKIM-MILK.	Water,	754.0 lbs.	Water,	754.000 lbs.
		Fat,	5.5 "	Solid,	3.740 "
				Fluid,	1.650 "
				Volatile,	0.110 "
		Albumen,	3.5 "	Carbon,	1.873 "
				Hydrogen,	0.245 "
				Nitrogen,	0.540 "
				Oxygen,	0.786 "
				Sulphur,	0.056 "
		Casein,	30.0 "	Carbon,	16.071 "
				Hydrogen,	2.142 "
				Nitrogen,	4.623 "
				Oxygen,	6.609 "
				Sulphur,	0.333 "
				Phosphorus,	0.222 "
		Sugar,	40.0 "	Carbon,	16.000 "
				Hydrogen,	2.440 "
				Oxygen,	19.560 "
				Water,	2.000 "
		Ash,	7.0 "	Phos. Acid,	1.890 "
				Lime,	1.820 "
				Potash,	1.190 "
				Chlorine,	1.120 "
				Soda,	0.665 "
				Magnesia,	0.280 "
				Iron,	0.035 "
			1,000 lbs.		1,000.000 lbs.

Main Elements of Soil Fertility in 1,000 Pounds of Milk — with Values.

	1,000 lbs. of Milk.		1,000 lbs. Milk, composed of				160 lbs. cream, composed of			
			840 lbs. Skim-Milk.		160 lbs. Cream.		126 lbs. Buttermilk.		34 lbs. Butter.	
	Weight. lbs.	Value.	Weight. lbs.	Value.	Weight. lbs.	Value.	Weight. lbs.	Value.	Weight. lbs.	Value.
Nitrogen, . .	6.010	$1.263	5.163	$1.085	0.847	$0.178	0.801	$0.168	0.046	$0.010
Phos. Acid, . .	2.247	.202	2.112	.190	0.135	0.012	0.108	0.010	0.027	0.002
Potash, . . .	1.275	.076	1.190	.071	0.085	0.005	0.068	0.004	0.017	0.001
Lime, . . .	2.950	–	1.820	–	0.130	–	0.104	–	0.026	–
	12.482	$1.541	10.285	$1.346	1.197	$0.195	1.081	$0.182	0.116	$0.013

Notes. — For values the prices assumed are: Nitrogen, 21 cts. per lb.; Sol. Phosphoric Acid, 9 cts.: and Potash, 6 cts. These values may change with the markets, but still remain relatively the same. Lime is not included in estimated values, its value being local.

Average Analysis of Milk, its Parts and Products.

	Milk.	100 Parts Milk Equal		100 Parts Skim-Milk Equal		100 Parts Cream Equal	
		16 Parts Cream.	84 Parts Skim-Milk.	7 1-2 Parts Cheese.	92 1-2 Parts Whey.	21 Parts Butter.	79 Parts Buttermilk.
Water,	87.50	76.00	90.00	45.44	93.32	12 00	91.10
Fat,	3.50	17.75	.65	6.40	.38	86.00	.78
Casein,	3.50	3.25	3.60	41.76	.43	1.00	4.09
Albumen,	0.10	.05	.30	1.60	.57	.12	.30
Sugar,	4.35	2.75	4.60	3.52	4.66	.80	3.43
Ash,	0.75	.20	.85	1.28	0.64	.08	.30
100 Parts,	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The first table may be called a reduction of 1,000 lbs. of milk to its lowest terms, or at least carried as far as present purposes require. As we are considering milk in its relations to the fertility of the soil on and from which it is made, it is only necessary to call attention to those elements which must be returned to the soil to maintain its productiveness. These are the nitrogen found in the casein and albumen of milk, and the phosphoric acid and potash contained in the ash. Lime is present in considerable quantity, and in some places this is a factor that must not be ignored. The water and carbon, hydrogen and oxygen are of no consequence in this connection, and the same is true of the chlorine, soda, sulphur, magnesia, iron, and perhaps the lime.

The table shows that in every one thousand pounds of average fresh milk, or whole milk, there are present, 6 lbs. of nitrogen, $2\frac{1}{4}$ lbs. of phosphoric acid, and $1\frac{1}{4}$ lbs. of potash (and 2 lbs. of lime). At the prices which are fixed as the value of these materials by the State inspectors of fertilizers, this portion of the milk is worth $1.54. That is, to return to the farm in commercial fertilizers, or their equivalent, what is removed by every 1,000 lbs. of milk sold would cost, at present market rates, $1.54, besides the hauling and handling. So, a gallon of milk is worth a cent and a half on the compost heap.

The very first charge which the milk producer should therefore make against every eight-quart can of milk sent from his farm is three cents for manurial value removed. This sum should be religiously set aside from the receipts, to be expended in a suitable return to the land. It is probable, however, that the plant food removed, and here valued at three cents, will really cost four cents to put back in an equally available form.

It may be better to look at this view of the subject in another way. It is certain that no one can afford to make milk to sell unless good, productive cows are kept. The cows of Massachusetts do not average 2,000 quarts of milk a year, while no cow is good enough to sell milk from that does not give more than this. It is easy in these days to find better ones. There are dairies of Holstein cows in the country that average 5,000 quarts of milk per year and head, for the herd. I have the records of several herds of Ayrshires, most of them in this

State, which show an average yield of 2,500 quarts, or 5,446 pounds of milk per head for several successive years, counting every animal in the head, which ever gave milk. The little Jersey is not usually considered the milkman's breed, but similar records of Jersey herds show an annual average of 4,987 pounds per head, or 2,300 quarts. I am now in charge of a herd of Jerseys myself, kept for butter and breeding, not for milk, but which have averaged 4,714 pounds apiece the last twelve months, one-third of the number being heifers with first calves. A year ago last October, I saw a promising heifer at the agricultural fair in this town (Northampton), and soon after purchased her for $150. She was not pure bred, and this was considered a high price, but she gave 8,434 pounds of milk, or 3,905 quarts in twelve months, with first calf. It has cost less to keep this cow than two of average quality, together giving less milk. The examples are cited merely to show that profitable cows are quite numerous, can be obtained at fair prices, and none others will do for the milk producer.

Let us assume, then, that no cow is fit for the business, that does not give 2,200 quarts or 4,768 pounds of milk annually. If this amount of milk per cow is sold whole from the farm, its manurial elements will consist of 28.63 pounds of nitrogen, worth $6.01; 10.71 pounds of soluble phosphoric acid, worth $1.07; and 7.03 pounds of potash, worth 42 cents, — in all $7.50.

This sum of money being expended in manures of any kind, by way of restitution, they cannot, by the closest economy, be obtained and applied without a further cost of fully half a dollar. This makes the round sum of eight dollars ($8.00) per cow, and when all other considerations of waste and losses from being unavailable are taken into account, it is reasonable to conclude that the sale of all the milk of a 2,200 quart cow removes from the farm on which she is kept what will cost at least ten dollars a year to make good again.

This item of expense in selling milk has been dwelt upon at length, because it is so often overlooked or under-estimated, notwithstanding its importance. How many milk producers are there in this State, who make it a rule to expend annually for every cow kept, from eight to ten dollars, for manure from

off the farm, to be applied especially to the pastures and grass lands? This return is made by many, in an indefinite and uncertain way, by the purchase of grain and other food for their stock. If this is done systematically, and the manure made is fully saved, the necessary restoration to the soil can be thus advantageously accomplished. It will not do to assume, however, that if one feeds a cow well, even provided all the grain be purchased, that full return is thus made to the soil for the milk sold. Without going much into details, let it be supposed that a cow is fed for two hundred days in the year a ration of four pounds corn-meal, four pounds wheat bran, and one pound cotton-seed meal, and that half a ton of bran is allowed "to help out the pasture," and that all this is purchased outside and fed on the farm. The manurial value of the feeding stuffs, computed on the same basis as in the case of the milk, amounts in round numbers to $7.00 per cow. This leaves only a small balance, it is true, between the sales and purchases of fertility (so to speak) but it is still on the wrong side. Buying feed, therefore, even on a liberal scale, does not offset the injury to the farm resulting from the sale of the whole milk.

The answer to the question, "Shall the milk be sold?" may therefore be in the affirmative, only *provided* the conditions are all what they should be.

In review, we see the most important of these conditions to be:—

First. The possession of productive cows.

Second. A steady and satisfactory market for the whole product.

Third. Such returns as shall certainly cover all the special costs of selling milk, and still leave a fair profit.

Reduce this to figures, and it means an average selling price of four cents or more per quart, for the year, and never less than thirty cents for a two-gallon can, or a gross receipt (including a calf) of $85 to $100 or more per year from every cow.

These are not prohibitory conditions, as might appear from the fact that the average receipt of the Massachusetts milk producer is less than three cents a quart, because this fact is largely the producer's fault. He fails to maintain the price

which is necessary to a living profit. The system of selling is all wrong. But this trouble is to be considered under our second division.

The value of milk as an article of food is becoming better appreciated by all classes, and the demand in the towns and cities is very rapidly increasing. This may be approximately shown by the statistics of milk sold in this State.

Year.	1855.	1860.	1865.	1870.	1875.	1880.	1882.
Gallons, . . .	8,203,665	12,038,372	15,149,483	25,284,057	35,698,159	40,662,953	42,000,000

The data from which these estimates are derived are very uncertain, but the figures may be regarded as relatively correct, although not giving the actual facts.

The annual reports of the milk inspector of Boston give the following estimates of the milk consumed yearly in that city : —

Year.	1862.	1865.	1868.	1872.	1876.	1880.	1882.
Gallons, . . .	5,840,000	5,887,085	7,185,390	9,227,930	10,001,000	12,075,660	12,500,000 *

The consumption has more than doubled in quantity in twenty years. Twenty years ago, the people of Boston paid $1,000,000 annually for their milk ; they now pay $3,000,000.

It is no wonder that farmers in Massachusetts, and New Hampshire also, strive to supply this growing demand, and there is no doubt that the business can be made profitable, if the proper conditions of production and sale are fully observed. But there lies the difficulty. So many have been attracted by the milk-selling business, that the production has kept closely up with the demand, and at times has exceeded it. Many of the producers, looking mainly to quantity, run the cost of production above safe limits, and make so much milk that they have no facilities for handling it at home, and must sell it or lose it. On the other hand, the dealers, encouraged by the quantity offered, hold prices as low as possible, and the result

* Five-sixths of this is furnished by Massachusetts farmers, and the rest, about 5,000 gallons out of 33,000 daily, comes from New Hampshire.

is actual loss, or a margin so small as to be quite unequal to the necessities of the case. The trouble is the system upon which the business is conducted.

At the present time, the system of selling milk in this Commonwealth, and throughout most of the country, is radically wrong. There is active competition in the market; those having the commodity, which they fear may spoil on their hands, or desiring to extend their trade, undersell their neighbors and keep the retail prices below what it is reasonable that the consumer should pay. The dealers (wholesalers, contractors, or whoever come next), take their profit out anyhow. The transportation must be paid, whatever it be. Then, what happens to be left is all that is offered to the producer. The whole loss falls on him, and it is because of this system that farmers have let their milk go for two cents, and even less, when consumers pay six or seven. Indeed, I know of cases where the producer of milk has received absolutely nothing for it, — what is known as surplus milk, in the cities, sent to commission men, being sold for less than enough to pay the freight and commission charges. Then,

II. "How shall the Milk be Sold?"

There is but a single answer. Milk must pass more directly from the producer to the consumer. A quart of milk is too small and too perishable an article to be often handled, and it has not value enough to yield a profit to several persons.

To bring about any sort of healthy condition to the milk-business, the present system must be exactly reversed. A fair price must be fixed as that to be received by the producer, based upon his investment and the current cost of production, and allowing a proper profit. There is no reason for much fluctuation. Generally, when certain articles are dear, others are cheap, — a good season usually follows a bad one — or, at least, the laws of compensation and average are such that the actual cost of making milk three hundred and sixty-five days in the year is just about the same, year after year. There is difference in localities; but we are now considering milk made at places which are so situated as to be able to reach a market. For all such, in this State, I am inclined to place the full cost of producing a quart of good milk, ready for market, at three

cents, the year through, and hence believe the farmer's price should be nearly or quite four cents, yielding him an actual profit of at least three cents a gallon. This is none too much — certainly no more than the producer's share; it amounts to not over six cents a day on every cow in the herd.

A fair price for the farmer is the starting-point. Next, a fair charge for whatever transportation may be necessary by road or rail, and then a fair compensation for the service of collection, distribution and delivery. The sum of these gives the final cost to the consumer. The intermediate charges — the shares received by the middle men — must be kept within bounds, for the retail price must have a proper relation to the cost of other articles of food. The consumer must not be called upon to pay too much, and need not be if the business is properly sytematized.

The intermediate charges necessarily differ with localities, but may be considered with approximate accuracy in three classes.

1st. Where the milk passes directly from the farm to the family, producers themselves delivering. This is usual in many of our villages, towns and smaller cities, and affords the best opportunity for giving satisfaction to both parties. One cent and a half a quart will usually cover the cost of delivering in such cases on a fairly good route, and this enables the sale of milk at an average of five cents and a half for the year, and yet leave four cents a quart for the producer. But when every other farmer near a village undertakes to establish a milk route, and neighbors compete and reduce the price to five and four cents, selling milk at once becomes a losing business. And it deserves to be so; I have no sympathy to waste on the sufferers in such cases. The consumers then get all the profit.

There is no reason why milk consumers in our villages should not be required to pay six cents per quart for a good article the year round. At this price it is economical food for the poorest people. At five cents it is much cheaper than any other standard article of food. With good boneless beef (the solid round steak for example) at 12 cents a pound, milk is really worth more than 6 cents a quart for food.

2d. Near our towns and small cities, where one middle man

is used. This person collects the milk from the farms, and delivers to the consumers. This service is worth fully two cents per quart, perhaps more. To support the retailer or route owner fairly, and still yield the farmers four cents, milk so delivered should average $6\frac{1}{2}$ cents for the year. A margin of half a cent is necessary to insure safety in these cases, and should go to the retailer or the producer, according to which one assumes the risk of the surplus milk. There is almost a certainty of such a surplus at times, and this system admits of no good means of saving it.

3d. The remaining class includes all shipping milk for delivery at a distance, where transportation has to be paid. The charge for transportation is the first additional expense. As a rule this is now exorbitant. There is no reason why milk should be charged a cent or a cent and a half a quart, 50 to 75 cents per hundred weight, when a barrel of sugar or of flour, weighing twice as much and worth four times as much, is carried double the distance for half the money. Half a cent a quart, or 25 cents per hundred weight, is ample for freight on milk, enough to cover all the special facilities needed. Allowing the farmer 4 cents and the carrier one-half cent, there remains $2\frac{1}{2}$ cents to pay for the service of delivery and risk of collection, leaving the retail price of city milk at 7 cents a quart. It cannot well be less, and this is low enough. Consumers generally are willing to pay this price for a good article. The ruling price in Boston and New York this winter is 8 cents for "dip-milk"; and much is sold at 10 cents in private cans and bottles. At 8 cents retail the producer is entitled to at least $4\frac{1}{2}$ cents as his share, or 38 cents for the $8\frac{1}{2}$ quart can. How many get it this month?

Two and a half cents per quart, or about one-third of the selling price, will doubtless be regarded as too large a share for the city retailer. With the prevailing system of small and independent milk routes, the retailer cannot make a living, delivering at the consumer's door, upon an allowance of less than this. It must be remembered that a large allowance has to be made for what is known as shrinkage. This loss in delivering milk at retail averages at least ten per cent. of the quantity handled. Seemingly improbable at a glance, this is an established fact, that the retailer who buys 100 quarts of

milk is able to deliver but 90 quarts to his customers. On some routes, where large numbers buy small quantities, the shrinkage amounts to 13 per cent.; and even at milk depots or stores it is seldom less than 8 per cent. Thus a retailer who buys 200 quarts at $4\frac{1}{2}$ cents ($9.00), and delivers on his route, at 7 cents, not over 180 quarts ($12.60), makes but $3.60, or less than 2 cents a quart, to pay for his time and the expense of his general outfit. And this, too, on the supposition that his shrinkage is within the average, and that he is paid for all; whereas more or less bad debts are usually the fate of the city milkman. Two hundred quarts make a good route for one man and one horse, and is not likely to average $3.50 per day. The difficulty is in the system of numerous long routes, half a dozen wagons often passing through the same street.

There is but one way to remedy this evil, and that is consolidation of the business and co-operation. I am a firm believer in co-operation in almost all branches of dairying, always provided it is properly managed. In the business of milk selling the advantages of co-operation are manifest no matter whether the sales be great or small.

In villages with but two or three or a dozen different milk routes, where the producing farmers deliver direct to consumers, a little friendly co-operation, instead of the cut-throat competition which so often exists, would be great gain to all concerned.

With the next grade in the business, supplying large towns and small cities, the best course is to establish a milk-depot —*dairy* would be the true name for it—but I suppose it would generally be called a creamery. To this central place the milk produced for sale should go, as generally as possible, and from it the deliveries should be made. They would be not only of milk, but of all its varied products, for the dairy or depot would be fitted to convert surplus milk into butter or cheese; and also to supply milk, cream, sour milk, buttermilk and cottage or "Dutch" cheese. Such an establishment might be a joint stock concern, owned and controlled by the milk producers, or the business of a single proprietor or of a firm. In either case the dairy would probably do a wholesale business, and also keep several teams of its own delivering to families.

Creameries of this character were established in Orange County, N.Y., some years ago, and so long as they were conducted on the plan for which they were built, exerted a salutary influence upon the milk business of the county, which is very large. (This one county sends as much milk to New York daily as the whole supply of the city of Boston.) But through negligence and mismanagement the manufacture of butter and cheese at these creameries has largely ceased, and they have become merely milk depots, with a decided tendency to "half skim," and sell cream, then sending the partly skimmed residue to market as whole milk. This procedure increases the surplus, lowers the standard and demoralizes the trade, doing exactly what the creameries were originally organized to prevent. This is no argument against co-operation in the milk business, but should serve as a warning against abusing a system good in itself.

The best example of a proprietary establishment of this kind in the country is what is known as "The Alderney Dairy" in the city of Washington. Its owner, Frank K. Ward, began on a small scale, peddling milk from a few cows of his own, but soon saw that the business was one which promised profit only by being conducted on a large scale, and with great system and economy. He bought out routes, made contracts with producers, and gradually enlarged his operations until he possesses one of the largest milk-depots in America, and almost monopolizes the best trade of the city of Washington in milk and its products. No amount of surplus annoys him, as the capacity of the Alderney Dairy is ample for storage, and for making butter and cheese. His business is now so thoroughly systematized as to be conducted upon very small margins, and he is enabled to supply consumers at very moderate rates, while at the same time he pays the producers more than they can elsewhere obtain in that vicinity. This establishment has many interesting features, and is in its way a model.

In the general system of city supply, on the largest scale, there is ample room for co-operation. In this case both producers and consumers should be included. Their interests are mutual, and they should be brought into harmonious and profitable relations. It is unquestionably practicable to en-

tirely do away with the middle men who are such a load upon the business of city milk supply. Of course the expenses in conveying the milk from the farm to the family cannot be avoided; but the *profits* now obtained by contractors, wholesale and retail dealers, can be pooled and divided between producer and consumer. Let us suppose the producer gets 4 cents per quart and the consumer pays 8 cents. If by joint action the 4 cents margin between them can be reduced to 2 cents, which I believe possible, there will still remain 2 cents to divide, — the farmer will get 5 cents instead of 4, and the family pay 7 instead of 8. Or even if one cent a quart only can be saved for such division, it is well worth the effort. To the farmer this would be ten or twelve dollars per head annual profit on every cow. But judicious co-operation will double this amount, and yield at least twenty dollars per head to the cow owners, over and above their receipts under the present system.

This is not individual opinion. Examples can be given of successful enterprises of this kind. I might describe to you the great co-operative dairying establishments of English cities, and large concerns like the Aylesbury Dairy Co., of the West End of London, and the Holland Park Dairy at Kensington. But there is no need of going out of our own country for proof of the benefits of co-operation in the business of producing and selling milk. There is an establishment which has been in successful operation in Syracuse, N. Y., for more than ten years, and it is simply a marvel to me that this is not better known, and that its results have not led to the formation of many others, before this time.

The Onondaga County Milk Association of Syracuse, N. Y.

This corporation was chartered and began business early in the year 1872. The capital stock was originally $25,000, but it has been a steadily prosperous concern, and has since increased its capital fourfold. The stock is held by about sixty persons who were formerly milk producers, and dealers acting independently, and it is apportioned at the rate of twenty dollars to each cow usually kept in milk by the holder; the stock-book shows that the members own from seven to seventy cows each. The headquarters of the association are in the city, where it owns and occupies a large four-story brick building

provided with every accommodation for receiving, keeping, handling and distributing milk, for manufacture of all milk products, for boarding and lodging the thirty or more employees and for general business purposes. There are offices, the directors' room, and a well-arranged hall for meetings and discussions by members of the association and other dairymen. In the rear are barns and stables for twenty-five horses, sheds for as many wagons, sleighs, harnesses, etc., also a repair shop, a blacksmith shop and other conveniences. The association maintains twenty milk routes, with a wagon and pedler upon each, supplying about 40,000 people through the year. Thus one wagon serves 2,000 persons, or about 400 families. The management is delegated to a president, vice-president, and nine directors, of whom five form the executive board, and the working force comprises a superintendent, cashier and accountant, milk-receiver, two distributing clerks, cheese-maker, hostler, blacksmith and helper, housekeeper and assistant, and twenty pedlers. All the help is boarded at the building of the company, and one of the most interesting items in connection with the enterprise is the fact that board satisfactory to the employees has been furnished at a cost of less than ten dollars a month.

The association originated from a prosaic desire on the part of milk-producers to benefit themselves, and a belief that several persons who were selling milk in Syracuse, each one by himself, could economize in labor and cost of delivery by co-operation. The object was to establish a central depot, where the milk produced by all could be received, thence distributed, so far as it could be used as milk, and provision made for working the surplus into butter and cheese, on joint account. The great saving expected was in the delivery to consumers; it was thought that instead of half a dozen wagons running daily through the same streets, to furnish here and there a family, as occurs often under the usual system, the customers of the six pedlers might, by union of interests, be supplied from a single wagon. Next was the expected saving by advantageous use of the surplus milk; that of several pedlers being "pooled" or handled in one mass. Both of these expectations have been so far realized as to give prosperity to the association. The inde-

pendent "owners" of milk routes at first looked with suspicion upon the concern, but one by one have found it to their interest to join. The impression of a monopoly, likely to be at first formed, is not sustained by the facts, for the association has opposition enough from individual sources to force it to keep down its prices and keep up the quality of its milk. The result has really been to maintain in Syracuse a high standard of quality and very reasonable rates.

Every member of the association has a business interest in having everything right, and giving the public full satisfaction. This leads them to sustain the management in making and enforcing strict regulations to insure cleanliness, purity and a good quality of product, and to ferret out any fraud and bring offenders to justice. Frequent tests are made of milk received, and close investigation as to causes follow all appearances of inferior quality or any irregularity. The directors often employ inspectors who are strangers to the producing members whose farms they visit, and their reports, covering the most minute particulars, are only made known to the officers of the association.

These interesting facts are derived from the annual reports of the association: There is the greatest consumption at the season of greatest production. The winter demand is somewhat reduced by the increase in retail price. Five cents in summer, and six in winter, has been the rule at Syracuse. The shrinkage or total loss in measuring, spilling, changing and cleaning cans amounts to 9 per cent. on the total business, and to 12½ per cent. on the delivery routes; in all, the association losses annually in this "shrinkage" the whole milk product of 120 cows. The total expenses average *less than one cent* a quart on the milk sold, and 84 cents for every 100 quarts of all the milk handled. This shows what is possible in the way of reducing the cost of city supply.

Fifty-two dairies contributed the milk of about 1,600 cows. The actual average product of the cows was 6.52 quarts per day, or 2,380 quarts per year, a very creditable showing. One owner of ten cows attained an average of 3,776 quarts per cow and year, and one owning 40 cows averaged 3,339 quarts. The lowest average of any member was 1,843 quarts.

This full description of the Onondaga Milk Association seems to be justified by its peculiarities and its excellence as a model.

The problem which it had to solve was: —

Would the savings arising from co-operation be sufficient to enable them to sell only pure, unskimmed, unwatered milk, at such prices as to give them a fair profit, at the same time meeting any legitimate competition that might enter the market?

The experiment has proved a success, and the association has, by its own honesty and by insisting upon the honesty of all who supply the milk, acquired the confidence of its customers, the people of Syracuse.

With such an example for guide and encouragement, I broadly declare that there should be twenty like it in Massachusetts. The farmers who produce milk in the neighborhood of any city of 40,000 inhabitants, or more, cannot afford to neglect such an opportunity for improvement, and consumers are equally concerned. The Syracuse method does not bring in the consumers as holding joint interest, as may fairly be done, and it will be noticed that there is no expense for transportation, the milk being delivered at the depot by the producers. But the Onondaga Company have so systematized the business and reduced the expenses, as to handle the milk, after reaching the depot, and deliver to consumers at one cent a quart or less. Add half a cent for transportation, as would be necessary in the case of the Boston supply, for example, and you have 1½ cents as the total cost between producer and consumer, instead of 3½ or 4 cents, the present cost of this middle service in most cities. Here is a saving of two cents a quart, if not more, to be secured by the producers and consumers, and divided between them, through co-operation.

These facts are sufficient to justify unqualified approval of the plans of Mr. Bowker and his associates in the proposed Massachusetts Dairy Company at Boston. The charter for that corporation, as granted by the State legislature, was carefully drawn and is admirably adapted to its purpose. I cannot understand how such a franchise is permitted to lie unused in Massachusetts. There should be a spontaneous

movement among the producers of milk on all lines of transportation centering at Boston, to bring this company into active operation. This is the proper season of the year for action. The consumers will share in the benefits, and should be appealed to, to aid in furnishing the necessary capital. At this season the largest individual consumers can be found at their city homes, and this is the time when they are paying the highest price for milk. It is also the season of the greatest cost of production among farmers, when they will certainly be interested, if ever, in increasing their returns. The stock ought to be taken in small amounts, probably not over ten shares, or $100 by any one person, that as many as possible may have a direct interest in the enterprise and share in its benefits.

It is by consolidation and increase of business under a single head that savings are made, every shade of decrease in expenses being clear gain. The margin is so small on a single quart of milk, that a very large number of quarts must be handled to secure economy. In short, the larger the business of such an enterprise, the surer its success. The size of Boston, and its rapidly increasing demand for milk, certainly gives every promise of success, even beyond that of the company at Syracuse. The Massachusetts Dairy Company should begin with a large capital, ample facilities, thoroughly prepared, and an abundant supply of milk secured in advance. This milk should all be taken from the day the business is opened, if only a hundred quarts are sold at the start. The equipment of the depot or dairy will enable the profitable manufacture of the surplus, no matter how great it may be. Of course the company will have its own distributing conveyances, its own ice supply, and at the dairy will be a centrefuge for quick cream separation, avoiding all "setting"—and the best arrangements for churning and cheese-making. The business of selling cream, skim-milk, sour milk and buttermilk, in the large cities is still undeveloped. It is one of the instances where a new and increasing supply will itself create the taste and the demand making the market, as has been done so conspicuously in the cases of small fruits and flowers.

The Massachusetts Dairy Company, although yet existing

only on paper, is too manifest a blessing to all interested in the milk market of Boston — except the middle men — to be permitted to long remain in its present quiescent state.

But all who produce milk do not send it to Boston, or sell it at all. Many believe, with me, that it should not be sold from the farm. Yet these people wish to keep cows and make milk, perhaps more than now doing. Indeed, half the cows in the State are owned by farmers of this class. To them applies the remaining division of this subject: —

III. "If Milk is not sold, what shall be done with it?"

This is a meeting of the State Board, and there are strangers present from distant portions of the Commonwealth, otherwise there would be no need of *my* now answering this question.

Agricultural gatherings in the valley of the Connecticut have listened often enough already to my views upon the uses of milk. Most of those here present need not be told that for some years I have allowed no opportunity to pass when I could properly advocate butter-making on the co-operative plan.

Three years ago this week, at the meeting of this body in my native town (Greenfield), I described the cream-gathering plan of butter factories, and explained its advantages. Nothing of the kind was then known east of the Hudson River. The next year the Hatfield creamery was established.

In 1881 creameries started work in Easthampton and in Lee. This year several more have been organized in this State and Connecticut.

To-day, standing within a half hour's ride of two butter factories, on the Fairlamb plan, in active and successful operation so long as to be well beyond the experimental age, I know you will pardon these personal allusions and justify me, in the most approved platform style, in "pointing with pride" to my record on this subject.

It will now suffice to briefly recall the chief advantages of the Fairlamb or cream-gathering plan of butter factories, in the light of experience, instead of the forecast and anticipation of three years ago.

Referring again to the relation of milk sales and soil fertility, attention is invited to the tables already presented, While it is seen that 1,000 pounds of milk contain nitrogen, phosphoric acid and potash, worth $1.54, the second table shows that of these elements seven-eighths are held by the skim-milk (value $1.34½), while in the cream there are only enough to be worth 19½ cents. Hence, in selling the cream alone, from a standard cow, the manurial loss for a year would amount to but 92 cents instead of $7.50, where the whole milk is sold. But under the cream-gathering plan, every patron of a factory may take home his share of the buttermilk. Look at the table once more. Of the 19½ cents worth of fertilizing material in the cream from 1,000 pounds of milk, 18¼ cents worth remain in the buttermilk, and only 1¼ cents worth go with the butter. Selling all the butter from a good cow will draw upon the fertility of the farm in the course of a year, to the extent of just about 6 cents. Here is the first and not the least of the advantages of contributing to a cream-gathering butter factory, and using the skim-milk and buttermilk on the farm.

Three years ago it was stated as *probable*, and by many ridiculed, that the factory product from the cows of a whole community might be made to equal in quality that of the best single dairies in the town; and, further, that the factory would make full as much butter from the same cows as could be done on the farm. Both of these expectations have been realized by the cream-gathering factories in this vicinity. According to the statements of local consumers, and the still severer test of the general market, no better butter is made in Hatfield and Easthampton than that of the factories in those towns. And I have the testimony of several farmers who send their cream to the factories, that the latter make even more butter per cow than could be done at home. One patron says that the gain in his case has been at least ten per cent.

The increase in the average quality raises the price, so that enough more is obtained to pay the factory expenses. During the present year the average price of creamery butter in the large cities of the East has been 34⅞ cents per pound for the very highest grade known to the wholesale trade.

The average selling price of the product of the Hatfield creamery for the year has been $34\frac{1}{8}$ cents, and for the Hampton creamery 35 cents. During the same period the average for the best dairy butter has been less than 30 cents. The Hatfield creamery, by close management, has kept its expenses down to $3\frac{1}{2}$ cents a pound, and thus netted its patrons for every 114 cubic inches of cream (not quite two quarts), something over 30 cents, or more than the average price of home-made butter. In Easthampton, the effect of sending creamery butter from town, several thousand pounds a month, has been to create a scarcity in the local market, and keep the price of dairy butter higher than ever known there before. In this instance, the cow owners not contributing to the factory have been benefited by its existence almost as much as the patrons themselves.

The general effect of this kind of factory has been to produce as much money revenue from a given number of cows as ever before, while the cow owners and their families have been saved all the time, labor and annoyance of making and marketing the butter.

As nearly as can be ascertained, the patrons of these new factories have obtained for the cream of their milk, skimmed and removed by the factory agents, almost three cents to every quart of milk, being nearly if not quite as much as obtained on the average by the producers of whole milk, who have sold it, in this State. Besides this, with no more labor than in the case of milk-selling, the factory patrons have had all their skim-milk left sweet upon their farms. Judiciously used, this is worth at least a cent a quart more. I believe, from all I can learn, that those farmers who have during the present year sent their cream to Fairlamb butter-factories in Massachusetts, have netted just about four cents a quart for their whole milk produce, with a minimum of dairy labor.

One important point is as to the equity of the system among the different cow owners contributing to a factory. How does the owner of the best of butter-stock, well kept, compare with his neighbor who has inferior cattle? Perfection is not claimed for the system, but it certainly comes nearer to perfect equity among the patrons of a factory

than any other known. With the better cows and better care more cream is obtained, and thus more money. The good stock has a much greater advantage than in any existing system of selling milk, where, in the general market, if not so poor as to be wholly rejected, the produce of one dairy stands on a par with all others. There is but one qualification necessary; owners of really inferior stock, and neglectful at that, will reduce the average of the factory both in quantity and quality. The cream from such farms should be absolutely rejected.

The testimony is uniform, that the effect of substituting the Fairlamb plan for the old system of home butter-making has been a wonderful relief to the farm household. On any farm where milk-selling has taken the place of butter-making, this relief can be fully appreciated. This cream-gathering butter-factory system affords precisely the same benefits in saving domestic labor. In short, wherever a creamery of this kind has been established, it is pronounced a blessing to the community.*

If you are making milk, anxious to sell it, and have to depend upon a limited market, don't go into competition and ruinous rates, but join your neighbors in maintaining a fair scale of prices.

If living near any place which consumes the milk of 500 cows or more, do not let the season pass without leading in a co-operative movement for a dairy or depot for joint delivery and general distribution.

If you are shipping milk to a distance, especially to Boston, join at once in putting the Massachusetts Dairy Company, and others like it, into active and successful operation.

If producing milk, but still wisely declining to sell the whole article unless you can get five or six cents a quart for it, a believer in skim-milk and butter-milk as economical food for all kinds of live creatures on the farm, and also anxious to be rid of home butter-making, help to start a factory in your neighborhood on the cream-gathering plan. Don't hold back to see how it will work, and, above all, do

* January, 1883. It is said that the proof of a pudding is in the eating. As evidence of the beneficial results of these butter-factories, a greater number are now in process of organization in Maine, Massachusetts, and Connecticut, than were in existence in New England when this paper was written H. E. A.

not hesitate because it may help others more than you, as is quite likely. The man who will refuse to benefit himself and his family from fear of helping others, and the one who remains inactive waiting for others to do work which will benefit him, must both be near akin to the individual who is said to have bitten off his own nose to spite his face.

In short, if interested in the milk question, be not content to let things remain in their present unsatisfactory state. Be active and earnest; organize — organize! *Do* something, when so many ways are open. It is work, and not growling, — *work* for your own interests and those of your fellows, — that is needed to settle the milk question.

Mr. West of West Hadley. I would like to ask the lecturer the most proper feed for a butter cow.

Mr. Alvord. You ask me too much. "A combination of feeds" would be my answer to that.

Mr. West. What combination?

Mr. Alvord. It might be any one of several combinations. I should say, corn meal and oats to start with, with perhaps a little cotton seed. Then, if the oats were left out, increase the cotton seed and add wheat refuse of some sort. But I would stick to the corn meal as the basis, and would not allow cotton seed to be omitted, if it was possible to get it, unless oats could be used economically and in abundance.

Mr. Sessions. Will cotton seed fed to milch cows make good butter?

Mr. Alvord. It will, if properly fed, and not too much of it. The quantity depends entirely upon the cow. It may stand nothing at all, or may run up to five pounds without any effect upon the butter, or but a very slight effect upon the butter.

Mr. Warner. What has been the average return per quart to the producer of milk through the system of butter factories?

Mr. Alvord. The factories have no means of keeping a record of the quantity of milk which their different patrons make. The only record which can be obtained from the books of the factory is the number of inches of cream which

come from each dairy. That is one of the things which I have endeavored to find out, and been the least successful about. I will not attempt to give even an approximate idea of the return per quart of milk under the system, but I know about how much butter may be expected from a given quantity of milk, and hence by obtaining the amount of money received for cream at the different factories through the year, I can get at the matter nearer than in any other way. My recollection is that the returns during the last year on cream have been upwards of thirty cents an inch at Hatfield, and at Easthampton about the same — in the neighborhood of from thirty-one to thirty-two cents per inch of cream.

Mr. WARNER. Those unfortunate people who sell milk for the Boston market don't know what you mean by "an inch of cream."

Mr. ALVORD. This inch of cream, as paid for by the factory, means an inch in depth on any can which gives one hundred and thirteen cubic inches. Now, one hundred and fifteen cubic inches is two quarts of cream, and one hundred and ten cubic inches, in the experience of the factories, gives a pound of butter. Hence, persons who have received thirty-one or thirty-two cents an inch for their cream have been receiving about thirty-three cents a pound for their butter, and, as nearly as I can ascertain, the average has been about eleven quarts of milk to the pound of butter. Hence, as nearly as I can get at it, the patrons of these butter factories have received three cents a quart for their milk, and had all their milk left sweet on their hands besides.

Mr. SHEPARD of Westfield. I would like to ask the speaker whether he considers it profitable to feed ensilage to cows?

Mr. ALVORD. The gentleman inquires in a very broad way about ensilage. I should have to ask for the appointment of another meeting, and a very liberal time allowed for the discussion, and some six or eight months in which to satisfy myself on the subject, before attempting to answer the question. So far I believe that the silo is a convenient thing to have, and it can be used to advantage during the season, and the stuff which you take out of it will answer very generally the place of roots in the ration of a milch

cow. Beyond that I am not prepared to go on the subject of ensilage in connection with the dairy.

Mr. SHEPARD. In regard to the feeding of roots, have you come to any definite conclusion as to the value of roots as feed for milch cows — turnips, for instance?

Mr. ALVORD. That is another wide question. I should answer it in the same general way, if I attempted to answer it at all. The value in dollars and cents it would be almost impossible to fix. The value of a root ration in the feed of of a cow is in the thrift, health and general condition of the animal. In her better appetite for her other food, rather than in any direct effect, in the ordinary quantity in which roots are fed in this country, upon the milk production. But I should say that there is no difficulty, whether the farmer is selling milk or making butter, in feeding enough carrots, parsnips, beets, turnips or cabbages (I do not include onions) to a cow to materially benefit her, without any perceptible effect upon the butter product.

QUESTION. Have you ever made any experiments to show how much hay is required to make a quart of milk?

Mr. ALVORD. It depends a good deal upon the cow. When you ask how much coal it takes to run a locomotive, you must remember that there are a good many railroads, and a very large number of locomotives, and strike an average. When you talk about a single one, you may be very wide of the mark as regards another, or the general average. And so in the case of a cow, I should say it depended, first, upon the cow, and, secondly, on the hay; so that to get at any sort of definite answer to that question would require a vast number of experiments, sufficient to eliminate the great margin of liability to error that exists in talking about hay, and in talking about cows.

QUESTION. I only asked to see whether, from your large experience, you could answer the question.

Mr. ALVORD. It needs a larger experience than we have had in this country.

Mr. HILLMAN of Marlborough. I do not wish to intrude at all upon this meeting, but I wish to add one word, hoping it may help somewhat in disposing of this milk question. I will confine myself to the topic of the essay to which we have

just listened. I had the pleasure, a year ago this week, of visiting the headquarters of the Onondaga Milk Association at Syracuse, and I am most happy to bear testimony, the strongest and fullest possible, to the correctness of the statements made by Mr. Alvord in regard to what that association is doing. I have a married daughter whose family have been supplied by this association for the last five years, and they testify to the uniform good quality of the milk furnished by them. They have received their milk at a cost of four, five and six cents a quart, at different periods. The superintendent of this Association, who took me over the whole building and showed me all the details, stated one point which is slightly at variance with one of Mr. Alvord's statements, and is more favorable to the milk producer and to the consumer. I think you stated that the milk was delivered by the producers?

Mr. Alvord. At the depot.

Mr. Hillman. The manager stated to me that that was not the case. The wagons distribute the milk in the morning, and then, after resting during the middle of the day, the same teams are sent out, in the latter part of the day, among the farmers, to collect the milk, which you see is much more economical than for the farmers to be obliged to bring their milk in; and this whole expense of collecting and distributing among the consumers and sellers, of collecting payment for the milk, and the losses, every expense attending the business, is covered by less than one cent per quart. So that when milk was sold in Syracuse at four cents per quart, the producer was receiving, net, over three cents, and when it was sold at five cents, he got over four cents. That is a case of economical management and cheap handling. It seems to me that there can be nothing more perfect than that method of distributing milk, wherever milk is wanted.

Mr. Ware of Marblehead. One year ago, I was at Washington, and went through the establishment that has been alluded to by the essayist. I understood him to say that that was the best conducted system for the supplying of milk to be found in the country. Did you say that?

Mr. Alvord. Where there was a single owner of the establishment.

Mr. Ware. I believe that that statement is true, for I went through that establishment, and I was particularly struck with the perfectness of the system with which the city of Washington was supplied. It is called the "Alderney Dairy" there; not that they sell Alderney milk, altogether, but they make milk of a uniform quality, that is much better than the ordinary grade of milk that is usually supplied in cities. The owner, Mr. Frank Ward, sells two grades of milk; one he calls "broken milk," and the other "Alderney milk," and the "Alderney milk" is made a higher grade than the common grade of milk, by making a proper division. They take some of the cream from the broken milk and add it to the whole milk, to make it a better quality. That whole milk, or the "Alderney milk," they sell for ten cents a quart; the broken milk, which is rather better than skim-milk, they sell for five cents a quart, and the surplus is converted into cheese and butter. He has some fifteen wagons, and each wagon is loaded with the stock that has been ordered of the driver the day before — so much butter, so much cream, so much whole milk, and so much broken milk or skim-milk. An account is taken of all the stock which each driver takes. The wagons are prepared at six o'clock in the morning; every man must be on the spot and take his wagon; if he is not there, the wagon goes all the same, an extra man being put on. Mr. Ward wants his drivers only to sell milk. They are not expected to load their wagons or unload them, or to take care of the horses, or harness them; their whole business is to sell the milk, and everything else is prepared for them beforehand. When a wagon returns, an account is taken of the stock that remains unsold, and with it the driver delivers an order stating what he wants for his load the next day. He has charge of the load, and what he takes out in the morning is returned in the afternoon, or he is made accountable for it, so that Mr. Ward loses nothing: the driver is held responsible for every cent's worth that he has received. The establishment is conducted on the factory or creamery system. At one part of the establishment, the horses are kept — not near enough for any of the effluvia of the stable to come in contact with the milk. In another apartment he has conveniences for churn-

ing, in another conveniences for the making of cheese, in another conveniences for keeping cream. He can keep cream ten days or more in perfect condition. And then he sells butter. All of the butter has to be put into half-pound packages, marked with his name, and it is a first-class article. He has connected with his establishment a boarding-house or a department where his men are all boarded; a housekeeper is provided, as in some other places. There is a blacksmith shop and a repair shop, and everything is carried on in a perfect and systematic manner, and I judge from what I saw that it is a profitable concern. And, furthermore, I judge that the city of Washington is supplied with better milk than any other city that I ever knew of. I am not prepared to say that the milk is better than any milk supplied to any other city in the country, but I say it is better than any I ever knew of. They have a superior quality of milk, pay a fair price for it, have all they want, and if there is a surplus, it is converted into cheese or butter, and is sold as part of the product of this dairy. Mr. Ward has a large farm of his own, and raises a good portion of his milk; the other part is brought in from different farms in the country, left at the depots in the city of Washington, and his wagon takes it there and delivers it at his place in the city, where it is manipulated in the manner I have described. Everything is kept in perfect cleanliness; there is plenty of water about the institution, and it is the most perfect and the most systematic method of conducting the milk business that I ever saw.

Mr. Alvord. There is a single point which has not yet been alluded to, which perhaps ought to be mentioned. You can very readily see that a family taking milk from a single person, particularly if he represented that he was selling his own milk, might not like to change and take a quart or a few quarts out of a large mass coming from they do not know where. There are always particular customers in every place. This objection is overcome, both at Syracuse and at Washington, as well as at other places where any such large business is undertaken, by furnishing milk to a particular family from the same dairy every day in the year, for a very small additional charge, half a cent or a cent a quart;

and then, at a further additional charge, in cases of invalids and children, providing the milk of the same cow. So that these objections on the part of customers which might naturally arise to the system are easily removed.

The establishment at Syracuse has been mentioned, the proposed company in Boston, and this private enterprise of Frank Ward's in Washington. I refrained from mentioning the New York Dairy Company, the secretary of which, Mr. Weld, is present. I hope he will tell us something of the operations of that company while this subject is up.

Mr. Weld. I do not know that I have a great deal to say in regard to the milk business in New York. I am very happy to state our way of doing business. The company of which I am secretary has not been in operation long enough in New York to have obtained a very large number of customers; but the business is growing rapidly, and the system which we inaugurated meets with great favor. We know our cows to be healthy and well fed. They are inspected by practical men, and, whenever necessary, by a veterinary inspector. The farms are inspected periodically, the water is examined, and of course the milk is inspected every day. It is brought to the creamery, or to the bottling establishment, which is situated in Orange County, convenient to the railway station; in fact, we have a spur running to the door. The milk is then examined. If it is of the right temperature, odor and taste, it is accepted. It is then weighed, and is immediately cooled to a temperature as near forty degrees as we can get it, and then immediately put up in glass bottles holding a quart each. We make no fractions of a quart. Those bottles are filled full; the cover is closed over them slightly. The bottles are then packed with ice, either in the box in which they are to be shipped, or on tables which are arranged to save all drip. They are packed up to the neck in ice, and left until they are placed in the shipping boxes, which hold twelve, eighteen or twenty bottles each, and we have concluded that the smallest box, holding twelve quarts, is the best and most easily handled. These boxes are shipped locked; the bottles themselves are closed and sealed with a gum label which passes over them. They are packed in these boxes, filled with ice, and shipped in that

way. We pay the same for transportation to the railway company as if the milk was shipped in cans, because the same number of quarts occupies no more room packed in that way than in cans; in fact, less room, because the boxes can be piled as high as a man's head inside of the car, whereas, if shipped in the forty-quart cans, which is the form in which milk comes to New York ordinarily, of course the cans cannot be piled at all: each can occupies its own space on the floor. The bottles of milk are sold with the seals unbroken to the families, and of course they are sure that what they get is as good as we can possibly procure among the farmers in Orange County.

Mr. Taft. Those are sold for ten cents a bottle?

Mr. Weld. Those are sold for ten cents a bottle. When we were especially anxious to introduce the milk, and had a great abundance, we sold it for eight cents a quart. The ordinary price in New York is eight cents. It falls a cent a quart, and sometimes two cents, in summer, for a poor quality of milk, and it goes up occasionally for dipped milk, that is, milk that is served with a dipper, to ten cents in times of great scarcity. We pay a cent per quart to the railroad company for transportation.

A portion of the milk which we receive from the farmers is set for cream. That cream retails at forty cents a quart. Cream of very nearly as good quality can be bought at wholesale in New York at twenty cents, but as we sell it, it is put up in pint bottles, and sold in the same way as the milk, and is delivered in that way.

The advantages of the bottle system are very plain. If milk is delivered, as it is in New York, from forty or sixty or eighty quart cans, which are sometimes used, and dipped, in fine weather, with a few inches of snow on the ground, the milk is delivered in very good condition; but on a rainy day, with water dripping from the driver's hands and clothes, or on a dusty day, when all sorts of dust, and especially the dust of horse-dung,— which is the principal dust that we have in New York, — is flying, the milk is not in good condition, will not keep as well, and there is abundant evidence in the flavor, to anybody who knows what good milk is, that dipped milk is not and cannot be as good,

under certain conditions, as bottled milk, put up as we do it.

Mr. GRINNELL. What do you pay the farmers?

Mr. WELD. We try to make contracts with the farmers for two, three and four cents a quart, that will make an average for the year of three cents a quart, delivered at our bottling station. Of course we would prefer to pay a little more than the general price for milk, because we want to get the milk of the best farmers, and we do not quarrel with a man if he insists upon having three cents for his milk during one of the summer months, when the market price would not be more than two or two and a half cents, and so our contracts are a little above that price. Probably the prices we pay would average three and a half cents per quart during the year to the farmer.

Mr. GRINNELL. What is the loss in breakage?

Mr. WELD. There is a great deal of loss in breaking. I cannot give the figures exactly, but it may be called a heavy loss. The breakage is rather in the handling of the boxes of empty bottles than in any other way. There is a certain loss from stolen bottles, which it is very difficult to stop. People will use a bottle and deny having had it. For instance, a family that is in the habit of taking two bottles of milk regularly will one day take three, and of course we are glad to sell that third bottle of milk; but the bottle, which is worth about twenty cents to us, is very likely to be lost, because only two will be returned next day: the driver will forget the odd bottle. We have, however, systematized things so now that we charge a driver with his bottles, and he is obliged to account for them; and if we charge a driver twenty cents for a bottle that he does not return, it does not occur a great many times before he recollects. But there is another thing which we cannot stop. We are obliged to start our wagons with three hundred quarts of milk quite early; the routes are some of them long, and the wagons at this time of the year are off as early as four o'clock; people are not up and we have got to leave those bottles in some convenient place. Other people know where our drivers leave those bottles, and occasionally a bottle is stolen. The driver on his return trip will be told by the parties whom

he has served that his bottles have been stolen. There is a loss that there is no help for, that I know of. Then there is a loss on frosty mornings. Day before yesterday we had the thermometer below zero. Of course the milk in the bottles that had been left exposed froze, but the bottles are so shaped that the freezing of the milk in them does not break them. They are contracted at the neck, but the necks are pretty large; they are from an inch and a quarter to an inch and a half in diameter at the mouth, and covered with a tin cap. We have discarded the glass caps which we used at first, which were very pretty, very cleanly and sweet, and all that, but the tin caps are much more lasting; they do not chip. When people find pieces of glass from the tops in their milk they are very apt to complain. These tin caps are held down by a wire, and if the milk freezes, the caps will be forced up, to the disadvantage of the wire on top; they will stand three-quarters of an inch above the tops of the bottles; but on frosty mornings, when there is any suspicion of such difficulty, the driver is instructed to loosen the cap, leaving it still over the top, but loose; then, if the milk freezes before it is taken in, there is no harm done.

In regard to the breaking of bottles, we found that more bottles were broken in those twenty-quart boxes than in the twelve-quart boxes. If a man is handling one of those heavy boxes, it falls with a great deal of force when he pitches it into the cart in a hurry. The small boxes are more easily handled, so that we do not get much breakage, and we are saving a great deal in that item. Experience helps us in these things as well as others.

We find that the physicians are our very best friends; they introduce the milk. If they have been using poor milk and find ours, they are quick to learn the difference, and we have constant assurances from people whose children have fared ill on common milk of the excellence of ours, and so the business is spreading without much effort on our part.

Mr. Taft. I spent ten days in New York City and Brooklyn in August, and the family where I visited had young children. They bought the milk described by Mr. Weld, and I can bear testimony that it was just as good milk as those children could have had if they had been on

my farm. As they are my grandchildren, I take a great deal of interest in them, and I have been much interested in the statement that has been made here of the way that milk is distributed.

Mr. Weld. I would like to add one word. I tell my friends in the city that I drink better milk in New York than I can drink at home, on my farm, and it is true. The milk is cooled just as soon as it comes from the cow, down to sixty, or below, by the farmer. Then we cool it down to forty, and it will stay at about that temperature, covered with ice: that is its condition when I drink it in New York. I do not get such milk at home. We cannot keep our milk so well. We could do it, with the same care, but we do not do it, and no other farmer does. So that milk handled in that way is really better than the milk that a farmer's family gets, to say nothing of blowing the cream off of the top.

The Chairman. I see before me the manufacturer of the standard butter of the Boston market, Mr. E. F. Bowditch. Will he give his experience in feeding for butter and in the manufacture of butter?

Mr. Bowditch. Mr. Chairman, if I say anything, I must depart from the question under discussion, which is milk, for I am not a milk producer. My plan of feeding cows for butter is to give them the best of hay, corn meal and carrots, with a few beets in winter, and in summer the same feed of grain, with good pasturage or green cut stuff. I have tried sometimes, having had a few cows that I wanted to feed a little differently, feeding shorts or linseed meal, but the parties who have sold my butter for the last ten years will tell me almost immediately that I had better not try to feed my cows differently; that I am giving them something that makes a change. I have never been able to feed musty hay, or well-cured corn-stalks, which I believe in most thoroughly for feeding common stock. I cannot feed shorts. I cannot feed cotton seed. I must feed as I have stated to secure the best result. I can feed six, possibly seven quarts of beets, if I feed the same amount of carrots also, but I cannot feed that quantity of beets alone. That, in brief, is my experience.

Question. I did not quite understand what quantity of sugar beets Mr. Bowditch thought a person could feed.

Mr. Bowditch. Six or seven quarts at the outside, and that only when you feed an equal amount of carrots. You cannot feed that quantity of beets alone without their tasting in the butter.

Question. How much meal do you feed to a cow?

Mr. Bowditch. To a mature cow, four quarts of meal a day; younger ones in the same proportion. From two to four quarts. No high feed.

Question. Once a day or twice?

Mr. Bowditch. That is the allowance for a day, two quarts at a feed. I generally mix the dry meal, for convenience, with my cut roots, feeding them together.

Question. What hay will bring the most milk, timothy, or orchard grass, or what other kind?

Mr. Bowditch. I would rather have a mixture than any one kind. If I had got to choose, I should say clover and timothy rowen, mixed.

Question. Do you approve of feeding corn-stalks to milch cows for butter?

Mr. Bowditch. I cannot make as good butter from them.

Question. Can you feed green corn fodder?

Mr. Bowditch. Green corn fodder makes the poorest of butter. I always increase my feed of meal if for any reason I am reduced to feeding corn fodder in summer.

Question. I would like to ask if by feeding sweet-corn fodder, with plenty of ears mixed in with the stalks, any injurious effect would be produced upon the butter?

Mr. Bowditch. I do not know that there would be. I almost always have ears in my corn fodder. I never feed it until it is well tasseled out. I have never found any great difference in feeding sweet-corn fodder and Southern corn fodder. My cows do not indicate a difference, and I never noticed any difference in the product.

Question. Do you churn your cream sweet, or sour?

Mr. Bowditch. A little turned. I cannot make butter that will keep any length of time from sweet cream.

Question. Have you ever had any experience in feeding Hungarian grass, and if so, will you tell us what effect it has had on the butter?

Mr. Bowditch. If it is well cured, it comes very near being equal to good hay. For the first time in my life, I this year cut it early enough and got it well cured.

Question. What is the effect on the butter of feeding cotton-seed meal or shorts?

Mr. Bowditch. You get much the same taste in the butter that you have left in your own mouth from chewing cotton seeds or shorts. A greasy, slightly bitter taste perhaps would express it.

Question. Would cotton-seed meal have a bad effect if fed in small quantities?

Mr. Bowditch. I never feed in large quantities. I am speaking of small quantities. I do not mean high feeding.

Question. What do you call a small quantity?

Mr. Bowditch. I never tried to feed over a quart but once, and then I came near killing a lot of steers.

Question. You began with a quart?

Mr. Bowditch. I began with a tablespoonful. I may have increased it a little, but my cattle all showed that they were uncomfortable and I changed the feed. I have fed but very little of it and very sparingly since.

Question. How about linseed?

Mr. Bowditch. That has a less bad taste than either cotton seed or shorts, but I can feed only a very little of it. I can feed it to one cow out of twenty in making butter, perhaps one or two quarts a day, but if I feed it to two cows the parties who sell my butter will find it out.

Mr. ———. There is some butter made in Franklin County that commands as high a price in the Boston market as any that goes there, and the producer of that butter feeds two quarts of cotton-seed meal a day to his cows, and yet there is no complaint made by the customers. How does that happen?

Mr. Bowditch. There is a great difference in customers about butter. If it is butter that is very heavily salted, it may overcome a certain taste. I am speaking of what is called "fancy butter," that retails by the pound or half pound at a high price. The butter you speak of is butter that sells for forty or forty-five cents a pound, I suppose.

Mr. ———. That is higher than the average price. This

gentleman told me within a week that he received thirty-six cents a pound for the last lot of butter.

Mr. Bowditch. It was probably much better manufactured than some of the butter that is sent down to Boston from other places. There is a great difference in the manufacture of butter.

Secretary Russell. What do you call a good price for butter?

Mr. Bowditch. Thirty cents.

The Chairman. Mr. A. W. Cheever, of the "New England Farmer," advocates feeding corn fodder to milch cows. He keeps milch cows and makes butter. I would like to have him tell us how he does it.

Mr. Cheever. You have been questioning Mr. Bowditch about how he makes his butter, and he has told you as frankly as he can. He has told you why he cannot feed certain kinds of food. It is because his buyer, his commission man, if I may call him so, detects any change in the feed he gives his cows, and tells him he had better go back again. Now you should remember that there is no such thing as a standard best butter, any more than a standard best man, or best horse, or best anything. Mr. Bowditch's butter suits, perhaps, a hundred customers in Boston better than any butter they can get. They have become accustomed to its taste; they like it, and they are willing to pay eighty cents a pound for that kind of butter. Now, on the other hand, I have made butter from different food from what Mr. Bowditch feeds. It has gone to the same market, and (I do not say it in a boasting way) my butter, for some years, at its retail price, was sold five cents above his. And yet I feed shorts, I feed cotton seed, I feed corn-stalks, and I feed hay that is not always the best. Now, the explanation is this. My customers, somehow or other, have got used to butter made on my feed, like it, and are willing to pay for it, and that is all there is to it.

Now, do not go away from the hall feeling, every one of you, that you must not, on any account, feed cotton-seed meal to your own cows, because Mr. Bowditch cannot, and he will not, say that you should have that feeling.

There is a good deal to be learned about butter and milk.

Mr. Bowditch says he does not know anything about milk, and I sympathize with him fully. I do not want to be asked anything about butter or milk, because I do not know anything about it. Within three weeks I have lost money on three churnings of butter that I sent to Boston, that I thought I was making from the best kind of feed. I was feeding green barley, sown late in the summer, and cut, nearly all of it, before heading out, and before the ground froze and the snow covered the last of it. I fed that to my cows rather more freely than I usually feed them on rich green feed, and I found that my butter was not as good, but I did not think the trouble was caused by the barley. I had fed barley in the summer and in the spring, and I had fed it as late as I did this year; but for some reason (and I am inclined to think I must attribute it to the barley, owing, perhaps, to some peculiar condition that I do not fully understand), my butter was below average quality, and although I increased the quantity about twenty-five per cent. by that feeding, I lost in the price returned just about enough to balance it. But I went back again from good green barley, as I thought, to cured corn-stalks and shorts, which Mr. Bowditch objects to, and the quality of my butter went up again.

Now, as to the price. The retail price of my butter is seventy-five cents per pound. I am below Mr. Bowditch now. He has honors above me in this, that he can sell, at present, four times the quantity for eighty cents a pound that I can for seventy-five cents.

Mr. Bowditch. Was not that barley frosted? Had you not had a severe frost on it?

Mr. Cheever. It was frost-bitten, and I should attribute it to that, only that last year I fed frosted barley, frozen more than this was, and had no complaint. I am unable to determine what the trouble was. With my accidents, successes and want of success, I do not feel that I know anything about making butter or feeding cattle. I am feeding linseed meal now instead of cotton seed, because it happens to be cheaper. It is the "old process" meal.

Secretary Russell. Did you ever feed any of the "new process" meal?

Mr. Cheever. Very little.

Secretary Russell. Did you have any trouble with it?

Mr. Cheever. I did not feed enough to form any opinion. I have fed but one ton of the "new process" meal in all my experience.

Question. Has your dairy made as much butter on the same feed this season as in seasons past?

Mr. Cheever. I do not see how an answer to that question would help the point under discussion. My dairy may or may not have been in its usual condition.

Question. The point I am after is this. There is great complaint in many portions of this section of the State that the same dairy, in substantially the same condition, treated in the same way, does not furnish as much butter from the same amount of milk as formerly.

Mr. Cheever. I have no experience that would throw light on the subject. We have had a very dry season in the eastern part of the State. It has been, in many respects, a very unfavorable season for our farmers.

Mr. Hillman of Marlborough. I would like to ask Mr. Bowditch what kind of feed he was giving his steers when he injured them by giving them cotton seed?

Mr. Bowditch. Corn-stalks and straw.

Mr. Taft. I would like to have Mr. Sessions tell us what experience he has had in selling butter in Boston.

Mr. Sessions. I suppose Mr. Taft is driving at a story he has heard me tell, and wants me to tell it here. I am willing to tell it. Having heard of these high prices for butter, — seventy-five cents, eighty cents and a dollar a pound, — and the making of butter being my business and my wife's business, of course I had some curiosity to know about this matter, and wanted to see if there was not some way in which I could get such prices. So, being in Boston, I went down to the market where I understood some of this kind of butter was sold by commission merchants, and asked to see it. I wanted to compare it with the butter we made, by my own taste. The dealer said he had several different grades of butter, some that he retailed for sixty cents, some for seventy, some for seventy-five, and some for eighty cents a pound, and I don't know but higher. He showed me all

those kinds. It was put up in splendid style, in quarter and half pound packages, some of it wrapped in muslin — I don't know but embroidered muslin — and some in mahogany boxes. I tasted the butter, and it was splendid butter. He did not hesitate to let me taste the butter, which I thought was very liberal, considering it was so costly. It was, as I say, splendid butter, but I thought we had sometimes made as good butter at home as that. But never mind; I wanted to know if there was any possibility that we could get that price for our butter. I put this question to him. Said I: "Sir, I make butter, and I want to know, provided I send you my butter put up in equally good shape — it shall be equally good in every respect, you to be the judge, not I, — to this eighty cent butter, what you can sell it for?" "Oh," said he, "perhaps five cents above the market price." Said I, "How is that? You sell this butter for eighty cents a pound. Understand, my butter is to be equal to this in every respect, and put up in the same shape, and you shall be the judge, not I. Can't you get more than five cents above the market price for it?" "No." "Isn't there any way in which anybody else can get eighty cents a pound for butter?" "Oh, yes. If you have got influential friends in Boston, rich relatives, or anybody else that you can get to take half of your butter, and pay eighty cents a pound for it, I will get customers for the other half." "In other words," said I, "if I will contrive to make a market for my butter, then you will sell it for eighty cents a pound?" "Exactly so," said he.

Mr. CHEEVER. I want to put in a demurrer there, although there may be some truth in the statement. It is often easier for a man belonging to a highly respected and well-known family to enter good society than it is for an obscure man to do so; but family connections are not absolutely essential. In order to build up a butter trade in Boston, so that you will be able to get eighty cents a pound, you must not only have your butter good, but you must be willing to begin at five cents a pound above the market price, and you must sell at that price until your customers are willing to pay ten cents above the market price, which they will be by and by, if they cannot get it without. They

may be willing to pay fifteen cents, and in time you may get up to the eighty cents, provided there are wealthy people enough in Boston to take the product of Mr. Bowditch's dairy, and my dairy, and several others, which is a point yet unsettled. But real merit, in the long run, governs the market — not family connections.

Mr. Sessions. I want to ask Mr. Cheever if he honestly believes that his butter is worth double what some of the butter that Franklin County sends to market is worth?

Mr. Cheever. I do not, except to those who have learned to appreciate it, and are willing to pay for the assurance of a full supply at all times, and for uniformity in character.

Mr. Bowditch. I have sold butter for more than one year at forty cents a pound and less. I was a good many years building up my trade, and more than once I lost half a dozen of my best customers, and got a lower price for my butter, because something went wrong in my dairy. It is only when you have proved to a certain lot of customers that you can make butter, and have it the same every churning you send in, every week, every month, and every year, just the same, that you can establish and maintain a high price. The Darlington people in West Chester, just outside of Philadelphia, sell their butter, what little is sold in Boston, for twenty cents a pound more than any other butter that I know of. It is not always so very good; sometimes there are white streaks in it, but it is the fashion. I have tasted it when I did not like it as well as a good deal of the butter found in the Boston market.

Question. Do you put up any winter butter?

Mr. Bowditch. Yes. In the flush times, I try to make as much butter as I can. When butter is plenty, I may make one hundred and fifty pounds, instead of one hundred pounds, and get my full price for it. The way that I have kept up the price is this: My butter is retailed at a certain price, and any butter that is not taken by the retail trade is put into boxes, with my trade mark scratched off of them, and not sold as my butter.

Dr. Wakefield. It seems to me pretty hard for us here, when these distinguished doctors of butter disagree so,

to ascertain just what it is that gives value to that article. I make butter sometimes. I am making butter to-day for the Secretary of the State Board. Well, if there is a man in this world who ought to know what good butter is, he is the man. Now, I do not want to boast any more than these other men, but he told me the other day that I made him some of the best butter that he ever tasted. That butter was made from common feed. I have made butter from almost any feed, and I think that we can make pretty good butter if we take care of certain other things. Although I know there is a difference in the feed, I don't believe there is anything better than corn meal and early-cut hay; but I believe you can make good butter from cotton-seed meal, fed in small quantities. I don't think you can feed three or four quarts and make good butter or have a good cow long. I have never got so much milk or so much butter from a given quantity of feed as when I fed cotton-seed meal, in a proper manner, combined with the other things. I think that with roots, with shorts, with corn meal, and good early-cut hay, you can make good butter.

Now, the gentleman in front of us has told us how he can make good butter, and he has frankly told us how he can make poor butter, and he does it by feeding certain things. I know he can. I believe you can feed a certain quantity of turnips, you can feed a certain quantity of cabbage, and you can make good butter, but you cannot feed either of those to a great extent, and you have got to be careful how you feed them and when you feed them.

But to come back to the price of butter. Mr. Sessions has described, I think, just how this matter is. A man has got to establish his reputation. Mr. Bowditch and Mr. Cheever have got up to seventy-five and eighty cents a pound. Now, I have got up to only thirty-eight cents. I do not charge my friend, the Secretary, but thirty-eight cents for the best kind of butter, as he acknowledges. I suppose he ordinarily makes his own butter, but he has been so unfortunate as not to make his butter last. I suppose he is sorry, and I certainly am, not that he bought butter from me, but that he would not pay me eighty cents; that is why I am sorry. I would like to ask Mr. Bowditch if his taste

is sufficiently keen to tell what his cattle are eating, if he did not know it?

Mr. Bowditch. I generally know it before my people tell me.

Question. I would like to ask Mr. Cheever how he separates the cream from his milk?

Mr. Cheever. Perhaps you will call me "an old fogy," but I set my milk in the old-fashioned open pans, except in hot weather, when I use the Ferguson Bureau.

Now that I am up, I want to say that a butter consumer acquires a taste of his own, and it is perfectly natural that Mr. Bowditch should agree in his taste with his hundred customers, more or less. They have had a very uniform kind of butter for years; he follows a very uniform system of making it, and they have all become accustomed to the looks and the taste of that good Bowditch butter. But Mr. Beecher says the best fisherman is the one who catches the most fish, without regard to the cost of his tackle, whether it be a sapling with a hook on the end of a string, or expensive paraphernalia from the city. If you can build up a trade and get good prices for butter made from cotton-seed meal, or cheap hay, or corn-stalks, green or cured, it is a legitimate thing for you to do; indeed, if you can make good butter out of cheaper food, it seems to me you are really ahead of the man who must use the most expensive foods, especially if the price obtained is the same in both cases.

Before I sit down, let me say that I consider Mr. Bowditch the champion butter maker of America. He is ahead of the Philadelphia dairymen in my judgment. He has succeeded in securing a larger number of customers who are willing constantly to pay fancy prices for their butter than any man I know of in this country.

The Chairman. I would like to ask Mr. Bowditch, Mr. Cheever, or Dr. Wakefield, one question, and that is in regard to the feeding of cotton seed and shorts — if the effect of such feeding will not vary with the breed.

Mr. Bowditch. I don't think I could answer that question. We all know that in keeping a certain number of cattle we have always a great variation in individual animals, but I should suppose that the result of any particular feed

in the butter product would be proportionately the same, no matter what the breed of the animal might be.

Mr. TAFT. Your cows are largely Jerseys?

Mr. BOWDITCH. Almost all, now, sir; but I never fed any cotton seed to a thoroughbred.

The CHAIRMAN. I was just going to observe, that if I feed even a quart of shorts or a pound of cotton seed to my Jersey herd, I hear of it immediately from Boston. That is the reason I asked the question. I have heard farmers say that they fed cotton seed to short-horns and it made no difference in the butter.

Mr. BOWDITCH. Did you ever try feeding it to other cattle before you had your grade Jerseys?

The CHAIRMAN. No, sir, I never did.

Mr. BOWDITCH. There comes in the difference, again, in the manipulation and manufacture of your butter. Your experience would not be worth anything unless you had tried it on a herd of grade Ayrshires, or something else.

Mr. HADWEN of Worcester. The experience of the chairman, as well as the other gentleman, in feeding certain breeds of cattle with certain substances, seems to show that they discover the flavor of the cotton seed more in the product from one breed than another. I think there is no question about the truth of these statements. For instance, you may take Jersey cattle, where the fat is very largely stored on the internal organs, and where the food comes more intimately in contact with it, and you will find that the fat is a great absorbent of flavor; while in the short-horn, for instance, where the fat mostly lies on the outside, next to the skin, and is not brought in contact with the food so directly, you do not perceive the flavor of cotton seed, or any substance, as you do in a Jersey. Consequently, I see it often stated by those who have Jersey herds, that they have to be very careful in feeding any substance having a peculiar flavor, to prevent its being imparted to the milk and the butter. We know that the French, when they wish to extract the flavor of flowers, use olive oil as the best absorbent. Oils retain the flavor of flowers. I know from my own experience of twenty years or more in feeding Jersey cattle, that, if you expect to get good milk or good butter,

you must select their food with a great deal of care, even away down to water. It is only by this care that you can have first-class milk or first-class butter, in my view of the matter, from this kind of cattle, while perhaps you might, with other breeds, feed poorer materials without producing any unfavorable results.

Mr. E. P. Smith of Amherst. I have fed cotton seed this summer to twenty-five or thirty cows, from one to four quarts a day, and have not seen any injurious effect from it. I had one cow that I kept in the barn, and fed her cured corn fodder and two quarts of cotton seed, and I never had a cow do better.

Dr. Wakefield. My last experience in feeding has been with a herd of Ayrshires. When I was connected with the State institution at Monson, I had a herd of Ayrshire cattle, and as we required as much milk in that institution in the winter as we did in the summer, I tried to make a feed that would come just as near grass as I could, and I did it in this way: by a combination of early-cut hay and roots, giving them from a peck to a half of a bushel a day of carrots and beets, from the time they went into the barn in November until they went out in May to the pasture; and, combined with that, I fed a very little Indian meal, and occasionally cotton-seed meal, and always shorts. By this feed I was able to make nearly as much milk in winter as in summer. I think that this combination of early-cut hay, shorts, a very little cotton-seed meal, and these roots, to the amount that I have stated, gave me a food that was nearer the grass, which is the great desideratum that everybody needs for the production of milk or the production of fat. I do not believe there is anything better for milk or butter, or to lay on flesh, than good early grass, that the cows can crop from day to day. In regard to the difference in breeds, I have had a great deal of experience with Ayrshires and Jerseys, and I have never been able to see any difference between those two breeds.

Mr. E. L. Buell of Ludlow. I hope that those who are not experienced in butter-making will not go home and commence feeding the poorest feed to milch cows — musty hay, cotton-seed meal, and shorts — because some gentlemen here, Mr. Cheever and others, have said that they have suc-

ceeded in making good butter with this cheap and undesirable kind of material. Their cows must be exceptional. The best feed is not too good for a milch cow. As Dr. Wakefield has just said, early-cut hay, cured well, and corn meal, must be the basis for making good butter; while, as the doctor has just said, a small quantity of some other kind of food, and even a little swale hay, containing something that the cow requires, perhaps, to promote health, may be used to a slight extent; yet, as the basis, nothing but the best should be used, unless, in exceptional cases, feeding a small quantity of shorts, a small quantity of cotton-seed meal, and a small quantity of corn-stalks, if your stock relish them. If they are musty, the tendency is to produce a mouldy taste in the butter. There is no question about that at all. If the question is asked, "What shall we do with our swale hay, mouldy corn-stalks, turnip tops, etc., that we raise?" I would say, feed such material to young and growing stock. It will help growth and make bone, and produce a satisfactory animal. But when you come to making butter, please allow me to impress upon the minds of this audience the idea that none but the best can be used.

Adjourned to evening.

Evening Session.

The meeting was called to order at seven and a half o'clock by Mr. Haskell, who introduced as the lecturer of the evening Dr. Byron D. Halsted, managing editor of "The American Agriculturist."

FROM GRAIN TO EAR.

Corn is king. Without any exception Indian corn is the greatest grain crop of the United States. For the present year, the statistics show that the yield is not far from seventeen hundred million bushels. The vast cornfield that has given this immense harvest is more than thirteen times the area of the State of Massachusetts. Sixty-five per cent. of all our corn

is raised in six States, namely: Illinois, Iowa, Missouri, Indiana, Ohio and Kansas. Massachusetts is not, strictly speaking, a corn-growing State. Some one, whose love for length exceeds that for breadth or thickness, has carefully estimated that if all the corn grown in the United States was put into freight cars ready for shipment, and these cars were placed in a single line, the train would reach from Boston to San Francisco, or to the moon, I forget which. Millions of anything are not readily grasped by the human mind, and this calculation is only an attempt through mathematics to make the vastness of the corn industry stand out in greater clearness.

Though Massachusetts cannot boast of the largest acreage, she has good grounds for feeling proud that within her borders the first cornfield was planted by civilized man. The Pilgrim Fathers found this grain successfully cultivated by the Indians, and, guided by the instruction of the industrious squaws, the first crop was harvested in the autumn of 1621. From that time down to the present day, over two hundred and sixty years, the culture of the corn-plant has extended and its importance grown with the nation's growth, until we find it to-day a leading branch of our most profitable agriculture. Indian corn, the cherished child of the savage, has come to be the acknowledged king of all our crops, and each year it is leaving a richer and richer legacy of golden grain to the thoughtful farmers who skilfully administer to the successful reign of this royal plant.

The capabilities of improvement of the corn-plant, when given good treatment, are remarkable. It has a plastic nature, and quickly responds to any favoring conditions. On this account a vast number of varieties have been produced. The further we trace back in the history of this cereal the fewer the sorts found, and the poorer their quality appears to have been. It is more than probable that the existing varieties have all sprung from the same stock, which was as much inferior to our best sorts of the present day as the untutored Indian who grew it was beneath the intelligent farmer who rejoiced in a rich harvest at his last ingathering. The progress made in the past is like an index finger pointing to what may still be accomplished. There is no standstill

in nature. If neglected, Indian corn will degenerate; but if carefully and thoughtfully treated, it will steadily advance toward perfection.

The hundreds of varieties of corn have been classified in several ways; a common one is into field, sweet, pop, and husk sorts. Another grouping is into flint, Tuscarora, dent, and sweet varieties, in which the pop corns are included under the flints, and the husk corn is placed with the dent sorts. It is very difficult to make a classification, because the varieties are founded on one or more of a large number of characteristics. Some of the leading of these are the color of the grain; the number of rows on the cob; the size and form of the grain; length of time in maturing, etc. The field varieties include both flint and dent sorts that are commonly grown on large areas, and make up the great bulk of the corn crop. The sweet corns are so named from the large per cent. of sugar contained in the grains, fitting these sorts especially for the table when in the green state. The pop corns are hard, flinty kinds, with the kernels much smaller than in the field varieties. These grains contain a large percentage of oil, thoroughly distributed throughout the substance, and enclosed by a hard covering. When the grains are heated, the oil changes into gas, and expands to many times its former size, and bursts the kernel, turning it inside out in a most surprising manner. In the husk variety each kernel, as well as the whole ear, is enveloped in husks. It is thought by many who have given much attention to the history of the maize-plant, that this is the wild state of the Indian corn.

The range of height of full-grown corn is from more than twenty feet to less than two feet; from those giant growths, where the ears are so high that a man needs to be on a horse to be able to hang his hat on the lowest ear, to the pigmy sorts, where it is difficult to pass the corn-knife below the diminutive nubbin. The smallest ear, well developed and full grown, in a large collection recently seen, weighed one-half ounce, while the largest turned the scale at one pound and eight and one-half ounces. The number of rows of grain on an ear is always even and ranges from four to forty. The shape of the kernel is wonderfully variable. "It may be

nearly spherical, oval, elongated; it may possess a flat point or a dented extremity, or be furnished with a sharp tooth, either straight or recurved; it may be shaped like a horse's tooth, or be flattened; be longer than broad or broader than long; may be smooth or wrinkled. In color the kernel may be white, pale yellow, translucent, dark yellow, orange yellow, reddish yellow, red, violet, purple, blue slate, black or variegated. In texture it may be hard or brittle, soft and granular, and in some varieties almost gummy. Some weigh sixty-four pounds to the bushel, others fifty-six pounds or less." (Beal 1880, p. 281.)

In order to better comprehend the nature of our subject, it is necessary to look into the anatomy and physiology of the corn-plant, and trace, though briefly, its development from the planted grain to the ripened ear. When examined carefully, a kernel of corn is found to consist of a mass of starch and an embryo, both of which are packed closely together and inclosed in a protective covering. The embryo or "chit," as it is commonly called, is the vital portion of the grain and is a rudimentary plant, occupying a portion of the base of the kernel and extending upward nearly half way to the crown. When this chit is destroyed, as it frequently is by mice, rats and other vermin, the kernel becomes lifeless and worthless for planting. The embryo is always on the side towards the apex of the ear, and is the softest and most delicate portion — the part that children often separate from the kernel and eat, because sweet and tender. After the grain is placed in the soil under the favorable conditions of heat, moisture and air, it undergoes the process of germination. The young plantlet soon begins to enlarge in all its parts and, breaking the seed covering it, sends a number of roots downward into the soil, while the young stem elongates, the leaves pierce through the earth, and in a few days unfold in the air and sunshine. As the days pass, the roots increase in number and length, and by penetrating the soil in all directions in quest of food, they firmly anchor the growing stalk to the spot of earth that has been allotted to it. During the early life of the plantlet, it was supported by the substance stored up in the neighboring portion of the kernel. The starch

and oil that make up so large a portion of the grain, and for which the crop is grown, were prepared by the mother-plant to nourish its offspring during the initial growth. It is food put up in close quarters and in fine form near at hand, to be used by the young corn-plant until it becomes established in the soil and air and is able to shift for itself. The softening of the starch and its transfer into the growing embryo are among the leading chemical and vital processes effected in that early period of plant growth covered by the term germination. By the time the hot days of early summer reach us, the thrifty corn-plant has developed a large root system; the stem is elongating rapidly, and leaf after leaf unfolds and hangs in graceful curves. This growth is so rapid on the best corn days that some imaginative persons have stated they have both seen and heard the work progress. At a later stage of growth a whorl of roots is frequently thrown out from the first joint above the soil, which take an oblique direction toward the earth, where they enter and assist in gathering nourishment, and also aid in firmly supporting the tall and heavily laden stalk.

All agricultural plants are made up of three leading systems or members — the root, stem and leaf. The stem has its position between the roots and leaves; that is, the stem system stands between and separates in space, but bodily unites, the root system and leaf system of all common plants. In a large tree these systems are vast and complicated; but in our corn-plant there is comparative simplicity in them all.

The food that nourishes a growing plant enters it either in the form of a liquid or a gas. With the roots it is mostly as a liquid, water being the common solvent and vehicle of absorption. This water, containing the compounds of potash, phosphoric acid, nitrogen, lime, magnesia, sulphur, iron, chlorine, etc., is taken in through the many fine branching roots and rootlets. The absorbing area of the roots is very much increased by the vast number of fine tubular elongations of the surface cells, called root hairs. It is from the presence of these hairs that the earth clings so closely to the fine roots of a corn-plant when carefully lifted from the soil. Though seemingly very delicate, these almost micro-

scopic hairs force their way between the fine particles of the soil, and thus their thin absorbing surfaces are given a good opportunity for rapid action. The importance of a deep, mellow soil is clearly seen in the light of the above facts. The more readily the root hairs come in contact with the soil particles and the larger the absorbing surface which the roots present, the better it is for the plant.

The food elements which the root system absorbs pass into the stem, and from it into the leaves. In structure the corn-stem consists of a central pith with numerous imbedded fibrous threads, which pass in curved lines from joint to joint. The outside of this stem is a hard sheath, which gives sufficient strength to the stalk and protects the soft parts within.

The leaf is the laboratory of the plant world; in it take place those mysterious chemical changes that raise matter from the inorganic to the organic form. A cornfield with its thousands of rustling leaves waving in the noon-day sun is a scene of silent labor that is known only by its effects. The sunlight works in some hidden way within the green cells of the leaves and there transforms the crude sap that comes up from the roots and the gases that enter directly from the air, into the starch and other materials that go to build up the structure of the growing plant and the substance of the grain. Free entrance for the air is provided by the multitude of small openings in the epidermis or skin of the leaves. These stomata or breathing pores are so numerous in the leaves of some plants, that more than a hundred thousand may be found with the microscope upon a single square inch of surface. The amount of water that rises from the soil, is vaporized in the leaves, and afterwards passes out of the breathing pores, on a single acre of corn during a hot day, is many tons. The corn crop is grown during about one hundred days; that is, from the last week in May to the first of September. The value of this crop is estimated at seven hundred million dollars, whether sold in the kernel or transformed into beef, pork and other condensed forms of food. On the average, therefore, there are seven millions of dollars' worth of corn gathered from the soil and air on each growing day, and that without a sound audible to the

human ear. The thought is intensified when it is remembered that there are many cold days, during which very little progress is made, while on the warm, not to say hot ones, just following a fine rain, the growth is several times above the average. The farmer, when almost sweltering on a July or August day, can find consolation in the fact that between sunrise and sunrise again upwards of twenty millions of dollars' worth of work will be done in the production of our annual crop of corn.

There are three principal stages in the growth of a maize-plant: The first is the period of germination, when the young plantlet is nourished in its early growth by the food stored up as starch and oil within the seed-coats of the mature grain. Following directly upon this is the vegetation portion of the life of the plant, when it builds up its stem, roots and leaves out of the crude materials gathered from the soil and the air. Both of these stages are but preparatory for the third and last — the formation of the grain, or what may be styled the reproduction period. During the hot corn-growing days of midsummer the tassel, or upper and finely branched end of the corn-stalk, lifts itself above the broad, green leaves which had enveloped it as a scroll, and soon the plant has reached its full stature. The branching top continues to increase in size and beauty, while below at each joint a small branch develops. These are the young ears, one or more of which continues to grow and become the husker's reward at the time of harvest.

There are two kinds of flowers in the corn-plant. Those in the tassel at the top of the stalk are staminate or male, and their office is to produce the pollen or flower-dust that is needed to fertilize the young grains and cause them to grow to maturity. These male flowers are produced in loose, spreading clusters arranged upon the upper end of the stalk. The pistillate or female flowers are placed close together upon the side branch of the stalk, and make up the ear. Each young grain, closely covered by husks, has a long, slender thread called the silk, that extends beyond the tips of the husks and exposes its end to receive the flower-dust or pollen grains that are showered down from the tassels. The contents of the pollen grains find their way to the young

kernels through the silk, after which the fertilized grain begins to enlarge, while the silk, having finished its work in the plant economy, turns brown and withers away, though still held in place by the husks that closely envelop the growing ear.

The close relationship of the two kinds of flowers in the maize is sometimes very strikingly shown by what are known as *freaks* in the ear and tassel. These are of two kinds; namely, ear-bearing tassels, and tassel-bearing ears. In the first abnormal form the central spike of the tassel is developed as an ear, with its kernels, silk, and all that belongs to a true ear, excepting the covering husks. Sprouts or "suckers" often bear these at the ends of the stalks. In the tassel-bearing ears the opposite takes place, and spikes of male flowers are produced within the husks and close by the side of the ear of female flowers. These abnormal growths may be explained as follows: In most plants the stamens and pistils are found in the same flower. In the corn there is only one, caused by the suppression of the other. Thus in the normal staminate flower the rudiment of the pistil is found, and in the pistillate flowers the undeveloped stamens are frequently present. It would seem that in the abnormal cases, so often met with by the observing farmer, the pistillate part of the flower is developed when naturally the stamens only should have become perfect, and in that way an ear with well developed grain is produced in the tassel, while on the other hand some of the flowers that ordinarily develop into grains in the silk have given rise to spikes of male or pollen-bearing flowers. Unnatural growths are frequently the key to the true nature of a plant structure—just as a moderate state of intoxication may reveal the peculiar characteristics of the unfortunate inebriate.

The separation of the two kinds of flowers in the maize-plant renders what is known as crossing or hybridizing extremely easy — that is, in a field of corn the grains of one ear are very likely to be fertilized by the pollen showered down from the tassel of a neighboring plant. The truth of this is fully demonstrated when two varieties, as white and yellow corn, are grown side by side. There will be a mixture of the two sorts in nearly every ear along the border line.

After the time of flowering is passed the further work of the corn-plant is to develop the young germ of each kernel into the embryo plantlet, and to provide it with the necessary food for its future growth. The substance that has been assimilated by the green leaves flows to the growing ear, and each grain receiving its portion passes through the soft, plump, "milk" state into the glazed and hard condition of maturity. The whole plant has then finished its work, and death follows naturally, or is hastened by untimely frosts. The cycle in the life of the corn-plant is complete. It was first the planted grain, then the blade, then the ear, and then the full corn in the ear.

The average yield per acre of the maize grown in the United States is not far from thirty bushels, while the largest crop has exceeded two hundred bushels of shelled corn. In this instance the land was in a high state of cultivation, being thoroughly underdrained, closely planted, highly manured, and cared for in the best possible manner. This maximum crop is not held up as the most profitable one for all farmers to grow, but simply to indicate the possibilities of this remarkable grain. It doubtless would not pay most farmers to bend all their energies to the obtaining of such a yield, because there is probably a point, far short of two hundred bushels per acre, where it costs more to produce a bushel than the increase is worth. Just where that point is depends upon many circumstances and varies with the farm and the farmer; but it is safe to say that under the present conditions of our agriculture it is far above the average yield of thirty bushels.

Much may be done to improve the quality and increase the yield of our corn by a thorough and systematic selection of seed. It is not enough to plant plump grain separated from the small ones by a sieve. The work of selection should begin while the plants are growing, choosing those stalks that are of vigorous growth and furnish the best quality of fodder. They should be well eared; but this does not mean that the larger the number the better the plant. One fine ear is preferable to several small ones. Two good ears may be better than either.

The ears need to be well formed, and small at the butt,

that they may be broken off easily in husking. The husks should be soft, and loose when ripe, with the rows well filled out at the tip of the cob. The plant needs to be early enough to complete its growth during the short season, and not be cut down in the fulness of vigorous growth by the frosts of autumn. The stalks that have been selected to bear the seed-ears should have abundant space given them that they may make a perfect growth. Anything that increases the vitality of the grain will help in bringing a better crop. At present there are too many barren or earless stalks in every field of corn, and all such should be topped or cut out before they have time to shed their pollen and reproduce their kind.

The person who would improve his corn must keep in mind the leading law so closely observed by the breeders of domestic animals: "Like produces like." But along with this, there is a tendency to vary; and it is imperative that another rule in improvement be strictly adhered to, namely: Always select the best. Many trustworthy experiments show that, under the same conditions, one variety of corn yields more than double the crop produced by an inferior sort. These experiments teach, in the strongest language, the importance of planting only the best kinds of corn — those that through careful selection have developed strongly-fixed, thoroughbred characteristics, that specially fit them to succeed under the conditions with which they are surrounded.

Indian corn is a comparatively certain crop, and the farmer is almost sure of a moderate yield. In this certainty rests the danger of neglecting the means by which a much greater yield may be obtained. The farmer reposes in the confidence of forty bushels, when a little attention to improved sorts might bring an increase that is nearly all profit.

The introduction of new varieties of corn by crossing or by hybridizing is of great importance. By this means the better qualities of two varieties may be so blended in the joint offspring as to form a third sort that is superior to both of its parents. A hybrid, as the term is here used, is the result of the crossing or breeding together of two distinct varieties of corn.

"To hybridize this cereal successfully does not require i

the farmer any peculiar or unusual faculty; it is not the exclusive privilege of genius or the monopoly of gifted minds, but depends for success upon the plainer and more useful qualities of judgment, patience and careful attention." The farmer should have a clear conception of the qualities the new corn should possess, and select the two sorts having these characteristics predominating. Care must be taken that the planting is so timed that the tassels and silk threads shall appear simultaneously, or else no hybrid will be produced.

Enfield, in his work on Indian corn, remarks under this head: "The surest mode of reaching the highest results in hybridizing, though it would require more time, would be as follows: After carefully discriminating the several sorts to be used, let the cultivator improve each of these separately through a series of selections, and then, by crossing, let him propagate the intended sort from the more perfect types thus obtained. The new variety resulting from this mode of proceeding would afterwards be kept pure and still further improved by continuing the same process of selection. It would not perhaps be easy to foretell the extraordinary results that might, and probably will, be reached in thus improving the varieties of Indian corn by the joint aid of careful selection, judicious crossing and thorough cultivation." The person who is the fortunate originator of a variety of corn that is superior to any now in use, and thereby "makes two ears to grow upon a spot of ground where only one grew before, will deserve better of mankind and do more essential service to his country than the whole race of politicians put together."

A noted agricultural writer has said: —

"I believe it has been demonstrated that the character of the stalk, *branches* and leaves is derived from the male or sire's side of the house; and the style of the kernel, shape, color, texture, amount of starch, sugar and oil, gluten, flintiness, etc., come from the dam's side. Hence, if we want two to six ears on one stalk we should allow only those tassels to stand in our *breeding acre* which grow upon stalks on which several good ears are set. Then, with a little pains, we can fertilize the ears of the best stalks with the

pollen of their own tassels, thus probably adding to the 'prepotency' of the established tendency."

The large amount of information gathered by general experience and worked out by field experiments, teaches some important lessons as to the best conditions for the growth of corn. This cereal, though semi-tropical in its nature, readily adapts itself to the varying conditions of climate, and quickly makes a home among uncongenial elements. "Indeed, the important destiny for which this grain seems designed by the Creator is in nothing more apparent than in the extensive area which it covers, and the variety of climes in which it thrives. Though cultivated quite extensively, and with considerable success in Southern Europe, as well as in portions of Asia and Africa, yet America seems to be its peculiar home, and the region of its highest perfection. From Maine to Oregon, from British America almost to the verge of Patagonia, this legacy of the red man to the white, in some of its forms or varieties, is annually cultivated. Where frost-bound Minnesota lends to its growth a short and reluctant summer, where the rigor of a Canadian climate concedes to it a few weeks of glowing sun, or where the fervid sky of Kansas, or the sultry air and longer season of either Carolina, produce an earlier development and a larger growth; in short, wherever on this continent civilized man can exist with tolerable comfort, there you will find Indian corn pushing its little cylinder of folded leaves through the soil, or unfurling to the wind its long and graceful foliage, or lifting its newly-formed tassel to greet the rising sun." England would gladly give a thousand fortunes if she could successfully compete with us in the growth of this royal plant.

Although corn will grow on nearly every kind of soil, it is none the less sensitive to good conditions and responds freely to the highest kinds of culture. A good corn-ground is one that is rich, warm, deep and mellow. It is evident that the maize-plant needs an abundance of the necessary food in the soil, and it must be in an available form. The season of rapid growth is very short and there is no time to lose in waiting for the plant-food to be made soluble by any slow processes of chemical action. No previous crop of

any particular sort is essential to successful corn-growing. In some localities, as in portions of the rich land of Ohio, corn has been grown annually for upwards of a hundred years. In many systems of rotation corn may follow best after grass; that is, on a turned soil; but it is not essential, and with the above conditions of a rich, warm, deep and mellow soil a good crop may always be expected. The importance of each of these four conditions cannot be over-estimated. With no other crop is it more important to have the soil properly prepared before the seed is sown. If the soil is not already rich it must be made so with barn-yard manure, either alone or supplemented with commercial fertilizers. The depth and mellowness will depend much upon the native character of the soil, but if this is at fault it can and should be overcome as much as possible by tillage. The temperature of the ground will be determined largely by the season, but much may be done to fit it for good corn-land by thorough underdraining.

The proper time to put the seed in the ground varies greatly with the seasons. The difference in the time between the extreme northern and southern corn-growing sections is three or four months. For New England the time averages not far from the middle of May for the field sorts, though the season may vary two weeks either way from this date. The farmer is necessarily left without any fixed rule, and must act, as in many other farm operations, upon his own judgment. Some one has humorously remarked that it is far better to plant in well-prepared soil than in any phase of the moon, thus ignoring all of those influences that lunar observers have supposed our satellite has upon the growth of the earth's vegetation. The best guide in corn-planting is, perhaps, the old Indian one of the white-oak tree. When its leaves are as large as a squirrel's foot it is time for the squaws to make the holes in the warm earth and drop the golden grain. The same conditions obtain when the apple-tree is bursting its flower-buds and is beginning to clothe itself in that snowy covering of which poets write. "About corn-planting time" is when settled weather comes and the soil begins to warm up with the heat of long days and a high sun, and there is no better index of its arrival

than the stage of advancement that has been made by the trees of the orchard and woods. The seed should go into the ground so soon as the soil is warm enough for it to begin at once a vigorous growth.

The season's work in the cornfield is only begun when the ground is prepared and the rows are planted. Almost constant attention is needed from the time the first spear of green rises from the hill until the last ear is husked and the last stalk harvested.

The common idea of a crow is so clearly associated with the pulling of young corn, that to commend him to the good-will of the farmer may be thought next thing to heresy. There is no doubt that the average crow loves corn, and knows that at the base of a tender shoot lies a soft, sweet morsel. It is too often assumed that a busy crow in a corn-field is intent only on mischief, and by a constant warfare against him the more serious enemies, in the form of injurious insects, have increased. The days are few in which crows can pull the corn, while during the rest of the year they are friends of the farmer. This black-coated, coarse-voiced bird feeds upon the white grub and cutworms, and for this service should be spared. In many cases the crow pulls only the wilted spears of corn, and thus obtains the marauder that has done the mischief at the root. Let the crow live, and prevent him from having free access to the young corn by scare-crow devices during a few days, and thus reap the benefits of his good work for the rest of the year.

The number of insects specially injurious to corn is small. It suffers in connection with other crops when vegetation in general is attacked, as in the ravages of the army-worm, or as in the West, when the grasshopper sweeps all before it. Take the whole country through, many a corn-plant is cut off in early life by the white grub. The perfect state of this pest is the large, clumsy May-beetle or June-bug that makes so much noise for its size, when within a living-room, especially at evening, where there is a lighted lamp against which it can beat its head and burn its wings. The various cutworms are among the worst enemies to the young corn. In the spring they have keen appetites, sharp-

ened by a winter of fasting. Every farmer is familiar with the greasy, smooth and greenish look they have, coiled into a ball at the base of a young stalk, wilting from their recent attacks.

Weeds are the worst enemies in the cornfield, especially in the older parts of the country, where they have obtained a strong foothold in the soil. All cultivated plants when well cared for are unnaturally protected, and when these favoring conditions are removed they are easily vanquished in the struggle for existence by those plants that are the fittest to survive under neglect. The corn-plant is like a person reared under the influences of civilization, who would not stand in the wild woods on an equal footing with the savage, and could not hope to thrive when the advantages of his cultured life were withdrawn. The child of nature is at home in the wild forest, and will get a good living with only his hands and feet to aid him, while the civilized man would be lost in the race. So with the weeds: they are more than a match for the nursed and pampered grains and vegetables of the farm and garden. It is a part of the great economy of nature that no portion of a fertile soil should be without a covering of vegetation, and if the hand of man is withheld the weeds will soon weave a garment to cover the nakedness that the axe or plough has made. If a farmer will, and he should, show special favors to any cultivated crop, by giving its plants abundant room in a rich soil, he must accept the situation and enter the field as a champion for his crop and fight with the weeds for the right to the soil. He most certainly invites their presence by providing the most favorable conditions for their starting into a vigorous growth, and therefore should be active in holding the pests in check. In a new country it is of great importance to keep out all weed seeds from the soil; but in the older parts of the world, where the farms are well stocked with them, there must be added to this labor the destruction of the weeds already present. The earlier in life a weed is killed the better, thus giving it less time to steal plant nourishment from the soil, and preventing it from forming seed to continue the trouble. There is no royal road to weed-killing — no panacea for this disease of foul land. Weeds get their living in the same manner as

the corn-plants among which they grow; they need to have room for their roots in the soil, and space in the air, and sunshine for their stems and leaves. When deprived of these conditions death must follow sooner or later. To this end, and for the loosening of the soil, it is necessary that the corn have the encouragement that a frequent passage of the cultivator and an occasional hoeing will give. It is important that no weeds go to seed. If one out of a thousand is missed in the cultivation, and is left to perfect its growth, the sound seed may be almost as numerous as when all the weeds are left to struggle together through an imperfect growth. A few rank, seed-laden weeds in a cornfield will stock the land for years to come. From recent estimates it has been shown that a shepherd's parse-plant produces from 20,000 to 80,000 seeds; a curled dock, over 93,000; an ox-eye daisy, 96,000; a pigweed, 825,552; and a large pursley-plant the grand total of 2,146,500 perfect seeds. These figures are truly surprising, and show that much hard work must be done to keep such pests from possessing the soil. It is a satisfaction to know that the labor expended in killing the weeds improves the soil and increases the crop. Weeds in one light may be considered as blessings after all, as they put a premium on industry, and serve as a constant stimulant to the earnest farmer to attain to a higher and more profitable agriculture.

The last enemy of the corn-plant to be mentioned makes its appearance after midsummer, and is familiar to all farmers under the name of smut. This trouble is a parasitic plant, and a member of the order or group called fungi. Among the larger and more conspicuous of these peculiar plants are the mushroom and the various forms of toadstools. The moulds belong to the same family. There is a long list of these parasites that prey upon the various crops, among the leading ones of which are the potato rot, grape mildew, wheat rust, onion smut and black knot of the plum and cherry trees. The smut-plant vegetates in the tissue of the corn, and often does much damage to the crop. The dark brown dusty substance of the smutted ear consists of a large number of minute spherical miscroscopic bodies called spores, which serve the purpose of seeds in the economy of

the smut-plant. These spores germinate, and the young plants penetrate the substance of the growing corn-plant. The whole stalk and leaves are more or less affected with the fungus, but the spores are only formed in a few favorite places, the leading of which is the ear. The affected grains are first noticed of unusual size; they soon develop to larger dimensions, become soft throughout, and finally the interior turns into a black, worthless mass of smut-spores. Sometimes the smut is formed in the tassel, and in bad cases black bunches are produced on the joints of the stem and the mid-ribs of the leaves. Smutted grain is injurious to stock, acting both as a poison and a mechanical irritant. On account of the grain being closely covered by the husks, the presence of the smut at times is not manifest until the mature state is reached. The most available method of destroying the pest is to go through the field before cutting time and remove and burn all smutted ears and other affected parts. If the smut-plant enters the corn from spores clinging to the grains when planted, it is to be expected that a thorough cleaning of the grain would be a well-advised precaution. Soaking the grain in a weak solution of blue-stone or blue vitriol (sulphate of copper), followed by rolling in lime, has proved of value.

The uses to which Indian corn is put are most diversified and numerous, being interwoven with the daily interests of nearly every family in this and many other lands. A foot-sore and weary traveller in a tropical country came to the hut of a hospitable native. His thirst was slaked by a sour liquid and his hunger was satisfied with various savory dishes. When asked the source of all these substantial refreshments the host replies, "My cocoanut tree." Water is obtained from the green fruit, and a delicate flesh from it when ripe. The vessels in which the foods are served are made out of the shells of the nuts. The wood of the cocoanut tree furnishes the material for the construction of the cabin, and the broad leaves make the covering of the roof. The fibre of the foliage is woven into clothing, mats, sails of ships and all sorts of cordage. The delicate oil from the fruit is burned in a dish for an evening light. Having the cocoanut, the native is possessed of nearly all the necessities of life. As the traveller sets out on his journey his kind

host sends by him a letter to a friend written in ink made from the cocoanut stem, and upon parchment developed from the leaves. A single cocoanut tree is doubtless far more to the Indian, who claims it as his own with almost a feeling of religious awe, than a field of corn is to its more enlightened owner. Nevertheless, the list of uses which the latter serves is much longer and far more important. Directly or indirectly, corn in some form administers to the daily needs of civilized man. The starch of the grain may shine upon our shirt-bosoms, or appease the pangs of hunger, and as fuel the grain warms the home of the pioneer on the treeless prairie. "The wealthy resident of the metropolis, whose fastidious palate has not perhaps been educated up to the latest improvement in corn bread, dilates with complacency over his favorite sparerib or tenderloin without reflecting that the perfection of its flavor is derived from Indian corn." When made into syrup and sugar it sweetens life, and distilled as whiskey it drives dull care away. It is a national disgrace that so much of this golden grain is changed into an intoxicating liquid. When whiskey becomes the leading product of counties and even whole States, it is certain that a great blessing is transformed into a monster that curses the land. Aside from the long list of uses of the grain there are those of the stalks in their various forms, either as fodder or for green manuring.

The last but not least of the benefits of Indian corn to be here mentioned is its good influence upon the land. It does not grow to itself alone, and much of the labor that is put upon a cornfield should be reckoned against the succeeding crops that are much benefited by the attention given to the growth of the maize.

In whatever light we view the subject that has been chosen, whether in its rapid, tropical growth, or graceful foliage and noble stature, it is easy to recognize a most useful plant that bears the stamp of nobility in every fibre of its structure. In its history we see the rich unfolding of a remarkable capacity that should inspire every farmer with a strong hope of even better things to come. Its sensitive nature responds to every touch of thoughtful culture, and most richly rewards those who best administer to its necessities. From the

tip end of the lowest root to the topmost flower in the spreading tassel, and through all the stages of growth from the planted grain to the full ear, the corn-plant is truly "every inch a king."

The CHAIRMAN. I presume that Dr. Halsted will answer any questions that any one wishes to ask him.

Mr. WARE of Marblehead. There are one or two questions that occur to my mind that I would like to ask the gentleman. He stated, as is familiar to us all, that if two varieties of corn, say one yellow and one white, are planted side by side, the ears of either variety will be filled with kernels, some yellow and some white. Now, what I want to ask is, do you call that corn where there are different kernels in the same ear a hybrid?

Dr. HALSTED. That term needs explanation, I think. We can have a number of different kinds of hybrids. We have plants divided into species, and then those species are classified and arranged under different groups, called *genera*. Now, if we take the pistillate or female flower of one plant, that belongs to one genus — rhododendron, we will say — and the male flower of another plant of another genus — azalia, we will say — the product of the union of those two will be called in botany a genus hybrid. It is a cross between plants of two different *genera*. If we make a cross between the male and female flowers of the same species, then we will have a *species* hybrid.

Then, again, the cross may be between *varieties*. Take it in the case of the apple. Suppose you take a Baldwin apple flower (which is a perfect flower, possessing both male and female organs) and open it before the leaf portion of the flower opens, and take out the stamens, or take out the little sacks that hold the pollen; if, when the stigma, or female portion, is ready to receive the pollen, you put on that the pollen of the stamens of the Northern Spy, then, in the seed which you get from that female flower that develops, you will have a hybrid between two *varieties*.

When you come to corn, a variety is a very difficult thing to make out. You grow the same corn for half a dozen years on your farm, and you can tell the difference between

that and your neighbor's corn. Now, if you cross that with your neighbor's corn, you will get a cross between varieties. Does that answer the question?

Mr. Ware. Not exactly. What I want to know is this: you have a single ear of corn, that is filled with yellow and white kernels, perhaps the different kernels all mixed in. Now, are those kernels of white corn a distinct variety of white corn, and are the yellow kernels a distinct variety of yellow corn, or are they hybrids? Each kernel is as distinct and separate as if they grew on separate ears, but they are all mixed on the same ear. As you said, and as we all know, the pollen falling from the tassel makes a kernel of the same variety as that from which the pollen comes. Now, suppose there is a white kernel and a yellow kernel in the same ear, are they hybrid kernels, or are they distinct varieties, and, if so, is there any mixture in the varieties?

Dr. Halsted. In a case like that, you have two varieties of corn. You have white and yellow corn growing side by side. You are not at all sure that the pollen from the tassel of the yellow corn fertilized any particular grain in the ear. If we took the pollen from a yellow variety and put it on the flower of a white variety, and find a yellow grain in the ear, I should say that that particular yellow grain that has grown on a stalk that has developed from the white corn is a hybrid, because its father is yellow and its mother is white. I should think that that would be it, exactly.

Mr. Ware. There is one other point. I have noticed at huskings that the whole life and zest of the party depends upon a red ear. Now, here is a red ear that probably grew with this yellow corn, and there are no yellow kernels mixed with the red ones. I have noticed that when red ears grow, the kernels are all red. Why should they not come with yellow kernels and red kernels all mixed up? Or does nature provide for the fun and zest of a husking party by keeping these red ears entirely distinct? I cannot see why the kernels should not be all mixed in, the same as in other cases. If white and yellow and black corn are planted together, you know the kernels will be all intermixed. It is not so with red ears; they are *red*, decidedly. Perhaps this is a scientific question. At any rate, I do not under-

stand it. I do not see why these red kernels should not be mixed in with yellow kernels, the same as any other two varieties; but they do not come so; they come clear red ears. I should be glad to have that explained.

Dr. HALSTED. There is said to be a black sheep in every flock, and so you can go through the whole round of nature and you will find these "sports," as they are called,—distinct deviations from the normal type. I will not attempt to explain why it is. You will find in the human species such a difference in one individual from a class, that if it has white hair and so on, you may call it an albino. And so it runs through both the animal and vegetable kingdoms. That may be a reversion to an ancestral form.

Mr. SHEPARD. If those white kernels and yellow kernels that the gentleman speaks of, are planted separately, away from the influence of any other plant, will those kernels produce white and yellow grains, or will they be mixed? Will the corn that comes from those seeds be yellow or will it be white?

Dr. HALSTED. If I understand the question, it is like this: We have had produced on a stalk growing from a white kernel, we will say, an ear that has upon it a number of yellow grains; the question is, will the yellow grains develop yellow grains? I am not sure of it, because there are so many inter-crossings that you cannot tell just what the second product from the cross will be. The tendency to run back to the type is very strong, and it may be that in the next generation you will have white and yellow grains from the mixture. You are not sure. I do not know as you can lay down any law in regard to that. The whole matter of progress has been interfered with. The current has been broken up. You have had two streams running in, and you are not able to tell what the result will be.

QUESTION. Does this red corn ever mix with any other kind?

Dr. HALSTED. I don't recollect any instance of the kind.

Mr. SHEPARD. I have seen red grains mixed in with other colored grains on the same ear oftentimes, but red corn does adhere very tenaciously to its color, as if it was a strong variety.

Dr. Wakefield. I think President Chadbourne can shed some light on this subject. I wish he would state some facts which he has in his possession.

President Chadbourne. I think the Secretary of the Board will remember that some years ago when he was lecturing on horses, I lectured on the crossing of corn, and he complimented me by saying that my lecture on corn threw great light on the crossing of horses. With regard to this red corn, and the peculiarity of it in its tenacity in holding that particular color, will state an experiment that I made. My attention was first attracted by the fact that I found red and white ears growing in some pop-corn that my boy planted in the garden; — all the red ears, as my friend here says, perfectly red, and all the white ears perfectly white. I selected with my own hands a red and a white ear. I planted them the next year in different portions of a field by themselves. The corn from the perfectly white seed was two-thirds of it perfectly white and about one-third black, or deep red, with no mixture whatever, and the corn from the ear which was perfectly red, a large portion of it, was red, and the rest of it white; not a particle of mixture in it; just as distinct as anything could be. But now the curious fact is this: that near that red corn which I planted grew some sweet corn. I don't say that it was affected by the sweet corn, but when I planted that corn the next year I planted it with my own hands, and there was no appearance of its being mixed with this crossing I have spoken of. About half of the crop from that corn, when it grew, showed the marks of sweet corn all up and down the whole ear; not particular kernels, but the whole ear was affected, had the form of the sweet corn, although the kernels were black. I never suspected there had been any crossing until I planted the corn the second year, and the second year I should have taken the ears for perfect ears of the common rice corn, but it had the distinct outline of the sweet corn which had come from the pollen that was fastened upon it the year before. But it remained of a black color. That is the peculiarity, and you will see it in the stalk; clear from the roots to the top you will see black lines running through it. That peculiarity I cannot account for. But it is a remark-

able thing, the tenacity with which the stalk that bears black corn holds on to it and makes the color of the grain black. We have corn, you know, that is of a dark color, that has wavy lines running through the centre like rice, but it is remarkable how tenacious the stalk that bears red corn is in maintaining the color.

Professor STOCKBRIDGE. May I ask President Chadbourne this question: If he recognizes that as a reversion to the original type?

President CHADBOURNE. All the husking corn that I have ever seen is of the flint variety, no dark color in it at all. I have never seen an ear of husking corn that was anything other than yellow corn. This dark corn has sprung up in some way, I cannot tell how. I remember out in Wisconsin a kind of corn — I have forgotten the name they gave it, perhaps some of you have seen it — that has as many as eight or ten small ears, and I don't know but twenty, on a stalk from the bottom up to the top all around it, and that corn I remember had black kernels and white kernels and yellow kernels. The ears were all mottled with the different colored kernels. I never saw the corn at any other time or in any other place except at a State fair in Wisconsin. I don't know where it came from or went to, but I remember that particular kind of corn from the peculiarity in the production of the ears, which did not grow as in the ordinary varieties but started at the joints, each stalk producing a large number of those small ears that had black, yellow and white corn all interspersed.

Mr. ——. I have noticed this peculiarity with regard to red corn, that while white, yellow and blue corn mix readily, and we have a variety of variegated corn, I have never seen red and yellow corn mixed on the same ear, except in these variegated ears, which appear to be a distinct variety. I raise a large twelve-rowed yellow corn. A number of years ago, for the reason that a husking is a dull place without a red ear, I introduced a few kernels of red eight-rowed corn, and have planted it successively for five or six seasons, getting a few ears of red corn each year, and I have never been able to produce a mixed ear in color; but that red corn has twelve rows, showing that it is a

hybrid to the extent of acquiring that habit of twelve rows, but it will not mix in color.

President CHADBOURNE. Any one can see that that is the same law exactly as prevailed in the mixing of my pop-corn and sweet corn. While it did not change the color, the corn took on the character of the sweet corn, as the corn to which the gentleman refers took on the character of the twelve-rowed corn, without the power to alter the color.

Mr. SHEPARD. There was another point in the lecture to which I wish to refer; that is, the taking out of suckers. The lecturer recommended the early cutting of stalks which were not likely to produce ears. For a number of years I cut the suckers out of my corn in a small field. Old people said, "Your corn will not fill out." It would be supposed that if you took those suckers from the ground the corn would fill out better; I thought that was natural; but I have had to give up that idea. The fact is, as far as I have observed, and I have observed several years, that where I have cut out those suckers the corn has not filled out. I have tried to find a reason for this, because it would seem that the suckers were drawing the fertility from the soil, and that if they were removed the corn that remained in the hill would do better, and there is only one way that I have been able to account for the fact. The suckers come out later, they are in blossom later than the top tassel, they are very close to the silk, very close to the ears, and very heavily loaded with pollen, having double the pollen, at least, that there is on the tassel on top. Now I am inclined to think that the pollen on those suckers supplies any deficiency of pollen which may occur earlier, and therefore the tip end of the ear gets all the pollen it wants. I don't know how far the thing has been investigated. I have never read anything about it.

Then in regard to the smut. The smut appears on the tassel, as the speaker has said. I spoke of it last year at one of our institutes, and no one had noticed it. I saved some this year with smut on it to show, and I had the idea that the smut was propagated from the tassel and with the pollen. I think that is a very interesting point, and I think that the advice of the speaker as to the method of preventing smut is the best we have had; and that is, that the seed corn

must be treated as we treat wheat. Ever since I can remember, when we used to sow wheat, we would roll it in lime and then sow it, and thus get rid of the smut. I have never known a farmer to treat his corn in that way, but it is as necessary, probably, as it is with wheat. I should like to know if we can get any further information in regard to those suckers.

Mr. ———. If the suckers are necessary, how is it that they are not necessary to dent corn? As far as my experience goes, there are no suckers in the hills of that kind of corn.

Dr. HALSTED. I think the gentleman did not quite understand my point. I did not say, "cut out the suckers;" I said nothing about cutting out the suckers; but I said the barren stalks, the full-grown stalks without ears, should be cut down; we do not want those at all. That was the point.

Mr. J. W. PIERCE, of West Millbury, Mass. I would like to say one word about these barren stalks. I have made corn a subject of study for quite a number of years. This doctrine that barren stalks ought to be cut out is quite prevalent at the present time. I believe it is an erroneous doctrine. It came first to my notice through Dr. Sturtevant; I am not sure but he was the originator of the idea. I believed in it at first, but since then I have examined my cornfields repeatedly, going through them and examining these barren stalks, and I am satisfied that in almost every instance they are suckers. And, furthermore, by taking my knife and dissecting them, I have almost always been able to find embryo ears, and I believe that those barren stalks are almost always suckers which produce pollen, which finishes out the fertilizing of the ear. I do not know that there is any corn worth planting which will produce barren stalks, providing you fertilize it sufficiently. Plant your corn on good land and let your suckers grow. I believe they are needed to perfect the crop.

Mr. ———. I have planted a kind of corn that we call "premium corn," which throws up a large quantity of suckers. I trim my corn down to four stalks in the hill, and frequently have from twelve to fourteen ears on a hill with

that kind of corn, and of course there must be ears on the suckers. I have planted that corn for a number of years, and that is the peculiarity of it. So that the suckers are not always barren.

Adjourned to Wednesday at 9.30.

SECOND DAY.

WEDNESDAY, December 5.

The Board met at half-past nine o'clock, Hon. J. S. Grinnell of Greenfield in the chair.

Mr. RUSSELL. I regret exceedingly to have to take the place of Professor Goessmann this morning, who is detained by a sudden attack of illness, and to read a paper with which I am entirely unfamiliar, which contains some important tables, which he could make use of as I shall not be able to do. It is also a misfortune to you, inasmuch as I shall be unable to answer those questions which you would have taken so much interest in putting to the accomplished professor.

Before I begin to read the lecture, I wish to say that I am prepared to give return tickets over the Fitchburg road to anybody who has come over that line. I also desire to say that we are under obligations to the Connecticut River road for great courtesy in regard to their checks of return. That road has always treated the farmers of this valley with that reciprocal kindness that we have a right to expect from the railroads. The Canal Railroad positively refused to give us any return tickets whatever, or to take any notice of our meeting.

THE INFLUENCE OF CHEMISTRY ON THE DEVELOPMENT OF A RATIONAL SYSTEM OF STOCK-FEEDING.

BY PROF. CHARLES A. GOESSMANN, MASS. AGR. COLLEGE.

The importance of a knowledge of chemistry for a satisfactory explanation of various physiological and pathological questions arising in the study of animal life has been for ages recognized.

The attempt of Paracelsus (1540), and a succeeding school of physicians, to explain most intricate physiological processes in the animal organism by the aid of the limited chemical experience of their time, as well as by the assumption of an ill-supported analogy of chemical and physiological reactions, caused only a temporary decline in the appreciation of chemistry on the part of physiologists and physicians. The adoption of more exact modes of chemical observation towards the close of the last century, not only restored the former confidence in its teachings, but secured to chemistry, in common with physics, a controlling influence on the development of the more rational animal and vegetable physiology of the present day.

The introduction of the balance, by Lavoisier in 1783, into the laboratory of the chemist, for the purpose of studying the chemical changes of all substances under their treatment *henceforth by weight*, inaugurated the new era. A careful use of this instrument soon demonstrated two important facts: —

First: Matter cannot be destroyed.

Second: All chemical combinations are characterized by definite proportions of their constituents.

It became evident that, however thoroughly the various qualities of a substance might be altered, one quality could not be destroyed, neither by physical nor by chemical agencies — namely, its weight; and also that under whatever varying circumstances a certain definite chemical compound might have been produced, the same relative quantity of its elementary constituents is in every case required for its production. To account for the entire original quantity of the constituent elements of a substance throughout all its various stages of transformation, became an indispensable attribute of an acceptable explanation of an experimental observation in chemistry. The chemist of the new era, in the language of the founder of modern chemical, animal physiology, aimed at a more concise description of the observation and proposed to control the latter by number and weight.

The speedy general recognition of the above stated facts exerted soon a thus far unknown influence on many current opinions regarding the true character of well-known changes

of all kinds of substances; it controlled the proper selection of suitable subjects for future inquiry, and caused a more judicious choice of means to obtain the needed information.

Among the first important results of the application of careful quantitative modes of examination are found the determination of the composition of water, the analysis of the air, and a correct experimental demonstration of the function of the air in the process of ordinary combustion, as well as of animal respiration, information of the first importance regarding the topic under discussion.

For nearly thirty years, until 1820, inorganic substances almost exclusively engaged the attention of chemists.

The gradual perfection of analytical modes for the examination of inorganic substances had led to the discovery of many new elements. The study of their chemical and physical properties, as well as of their relations to previously known elementary substances; the analyses of minerals, of soils, of the ashes of plants, and of industrial products in general, had furnished abundant subjects for investigation during that period. Organic substances, on account of inefficient modes of analysis, had received but little attention; comparatively but a few chemists had devoted themselves thus far to the study of organic compounds. Most noteworthy among them were Thenard and Gay-Lussac, two distinguished French chemists, who followed the course pointed out by Lavoisier. The unsatisfactory condition of organic chemistry was to be changed materially by the genius and the indomitable will of one man, who at this stage of the history of chemistry entered the field of chemical research — Justus von Liebig. As the scientific labors of this remarkable man are closely identified with the development of the science of animal nutrition, I may be pardoned for treating somewhat more in detail of the circumstances which led him to exert a controlling influence on our present views regarding the science of stock-feeding. Having pursued the study of chemistry for four years at German universities, he had the good fortune to work for two years in the laboratory of Gay-Lussac at Paris, the most skilful experimenter in organic chemistry of the time.

Naturally inclined to the study of organic substances, he

felt soon seriously the great need of better modes of elementary organic analysis. His first efforts were therefore directed towards that end as soon as he returned to his native country, Germany, as professor of chemistry in the university of Giesen in 1824. The results obtained in that direction by him, and those who benefited by his instructions, after five years of careful work, are a lasting monument of skill and perseverance; they have made his name familiar to every chemist, and have earned for him the name of founder of organic chemistry. The rapidity of the execution of an organic elementary analysis, and the unsurpassed exactness of the analytical results obtained, tended to increase in an unusual degree the knowledge of the true elementary composition of many organic substances and placed the analytical modes of organic chemistry even above those of inorganic chemistry of the time. Enthusiastic students of chemistry from all parts of the world soon flocked to his laboratory, which, endowed by the munificence of the government of the duchy of Hessen-Darmstadt, opened its doors on equally liberal terms to all, without regard to nationality.

Supported in many of his intricate and most important investigations of organic substances by his life-long friend, F. Wöhler, one of the most thorough and most successful investigators during the past fifty years, and surrounded by numerous and interested pupils, who frequently soon developed into valuable assistants and successful co-laborers, he secured within a period of fifteen years, from 1824 to 1839, a rich store of experimental observations regarding the elementary composition, as well as other important qualities ot a large number of organic substances of every description. His superior knowledge of the characteristics of organic compounds induced him to venture upon the study of the essential proximate constituents of plants and of animals, their food, their secretions and their excretions; it may suffice here to refer in this connection to his examination of the nitrogenous substances of plants and of animals, of the blood, of the flesh, of the composition of the bile and of the urinary secretions. Liebig's main efforts since 1840 were directed towards the application of chemistry in agriculture and in physiology.

The name, organic substance, had thus far been reserved for the products of vegetable and animal life. Wöhler's successful artificial production of a prominent constituent of animal secretion — urea — in 1828, was still the only noted instance of a decidedly organic substance having been produced without the assistance of the animal organism. Only a limited number of scientists looked upon that discovery as the first practical demonstration of chemical possibilities regarding the study of vital activity. The production of organic substances in the organism of plants and of animals was ascribed to a peculiar agency called vital force, and it was not less almost universally accepted, that their chemical relations to each other as well as towards inorganic matter in general were widely differing from observations obtained in the study of inorganic matter.

Liebig dissented at an early date almost instinctively from that view. To him there was but one science of chemistry, equally applicable to organic and inorganic substances. Although recognizing at any period of his life the peculiar influence of the living organisms on the production of organic compounds, he did not hesitate to assume that the vital energy in its construction of organic substances would follow the general laws which govern chemical transformations.

The first systematic and concise statement of his advanced views was published at the special request of the British Association for the Advancement of Science at their Liverpool meeting in 1837, namely: "To report on the condition of organic chemistry." His reply to this flattering invitation is contained in a publication which appeared in 1840: "Chemistry in its application to Agriculture and to Physiology." This masterly presentation of the experimental observations of preceding times as well as of his own extensive investigations regarding organic compounds, not less than the bold enunciations of his personal views concerning their bearing on vital points in the life of plants and of animals, created an unusual sensation among scientists and intelligent agriculturists everywhere. The great influence of this publication, and its six revised editions, on the development of a rational agricultural practice, as well as on the science of physiology, is a recognized fact.

Liebig's services to animal physiology are prominent in two directions, namely: *First*, on account of his extensive analytical examinations of numerous organic substances, of the proximate constituents of plants which serve as food for animals, and of the chemical changes they undergo during their passage through the animal system; and, *second*, on account of the direction he has given to the modes of observation to be applied in the study of animal physiology, by substituting the empirical experimental methods for the speculative philosophical one of preceding periods. A cursory study of the views of leading physiologists before 1840 cannot fail to concede to him a controlling influence on our present views regarding the principles which underlie a rational system of animal nutrition. Liebig's classification of the constituents of the animal food into three distinct groups, namely, *Nitrogenous substances, non-nitrogenous substances, and mineral substances*, furnishes the frame-work of the more rational system of stock-feeding of to-day.

Although it had been noticed for years that some articles of animal food contained the element nitrogen as one of their constituents, whilst others contained none — nitrogenous and non-nitrogenous substances — experience has furnished ample proof during famine, in war, and under other exceptional circumstances, that one single article of food, in particular those which contained no nitrogen, could not sustain life beyond a limited period of time; yet no satisfactory explanation of the real cause of death in those cases had been advanced. The force of this statement may be deduced from a subsequent brief enumeration of some feeding experiments carried on by distinguished scientists between 1830 and 1840. Several of the following experiments were made in connection with a prize question offered for general competition by the "French National Academy," one of the foremost scientific associations of Europe:

"Is the animal gelatine obtained by the boiling of bones, a suitable animal food?"

1. *Experiments with non-nitrogenous Substances.*

(Sugar, starch, gum, butter, etc.)

Magendie fed a dog with sugar. The dog died on the thirtieth day, in spite of large consumption during the first period of the trial. Five-sixths of the muscles had disappeared, and even the fat was gone. Similar results were obtained when feeding butter; the latter passed finally undigested through the animal.

Tiedemann and Gmelin fed geese with dextrine and with starch. In the first instance the animal had died on the sixteenth day; its weight had been reduced from five and two-thirds to four and two-thirds pounds. In the second instance the animal had lived twenty-seven days, and its weight had been reduced from eight and a half to six and a quarter pounds.

2. *Experiments with nitrogen containing organic Substances.*

(White of the egg, flesh freed from fat, animal gelatine etc.)

Magendie fed a lot of dogs with the white part of eggs. After a few days of the trial, they preferred to die by starvation rather than to consume for any length of time the rich nitrogenous food. A second lot of dogs were fed with animal muscles freed from fat. They consumed, at the beginning of the trial, every one of them, from one to two pounds of that rich nitrogenous substance per day. All died between from fifty to seventy-five days. A third lot were fed with the animal gelatine obtained from the boiling of bones, which they consumed at first freely. They all had died before the twentieth day had passed by. The animals which served in these experiments had in every case lost their muscles and their fat. The result of these trials had left no doubt about the fact, that a single proximate organic constituent of plants or of animals, whether nitrogen-containing or not, could not be considered in itself an efficient animal food. The reason why it should be thus, or on what basis the various proximate constituents of plants and of animals should be compounded for a healthy animal diet, was evidently not yet understood.

Physiologists and anatomists had studied during preceding periods, the various manifestations of motion in the animal

organism; the forms and constructions of the principal organs, the history of their development and of their growth; the process of absorption and of secretion, etc., with a skill and a perseverance which deservedly called forth the admiration of the time; yet the character of many of the chemical processes which transpire in the living animal organism was but little understood, and their intrinsic relations to definite physiological processes, for obvious reasons, scarcely suspected.

The classifications of the various articles of animal food with reference to their relative feeding value, on the part of leading physiologists of that time, furnish one of the most striking illustrations of the change which has taken place in that direction. A classification of articles of food with reference to quantity and quality of their essential proximate constituents did not exist; the idea that some of these constituents might have to perform different functions in the animal economy than others did not yet enter into their consideration.

A cursory discussion of the circumstances which led to the recognition of the special functions of the principal constituents of plants in animal nutrition may serve as farther proof of the great influence which chemistry has exerted on our present notions of the relative nutritive value of our various articles of fodder for farm animals.

1. *Nitrogenous Constituents of Food.*

(Protein substances.)

Representative Forms.
- Albumen — Eggs, blood serum, plants.
- Casein — Milk; leguminous plants, beans, etc.; legumen.
- Fibrin (solid) — Blood changes into it; gluten in wheat, etc.

(They occur in the vegetable and animal kingdom.)

The beginning of a better knowledge of the special relations of nitrogen-containing organic constituents of the animal food to animal nutrition may be traced directly to examinations of that class of substances by Mulder, Liebig and his pupils from 1830 to 1840. Their extensive investigations of many of our farm plants proved, contrary to current opinions, that all plants, and all parts of these plants, contain

nitrogenous constituents of various descriptions, and as a rule in much larger proportions than generally conceded. Seeds and young plants showed more than natural stems and leaves.

Liebig was the first scientist who pointed out the close chemical relations which exist between the three principal forms of nitrogenous constituents of plants and of animals; namely, albumen, fibrin and casein.

He recognized, by careful analyses, an exceptionally large accumulation of these substances in the seeds of many of our prominent farm crops; and found also that the blood, the milk, the flesh, the muscles and the texture of animals showed similar remarkable features in their composition. He finally demonstrated, by actual experiment and otherwise, that the vegetable organism, or the plant, alone was capable of producing from more elementary compounds, like carbonic acid, water, ammonia and some mineral constituents, the complex nitrogen-containing proximate constituents of plants and of animals. As he had proved, also, that the animal was incapable of producing in its own organism the most characteristic constituents — as far as quantity and quality were concerned — of its own blood and flesh, etc., it became evident that the healthful and normal condition of the animal, depended in a controlling degree, on the amount of certain nitrogenous substances contained in the vegetable food consumed. The desirability of compounding the diet of the animal, as far as the supply of nitrogenous constituents is concerned, with special reference to the particular wants of its organization, as well as its conditions and its functions, became not less apparent. I need scarcely to point out that in the light of Liebig's teachings, the time-honored practice of using the seeds of our cereals, some prominent leguminous plants (clover, beans, pease, etc.), the brans and the oil-cakes for enriching the fodder of farm stock finds for the first time in the history of agriculture an intelligent explanation. Liebig called the nitrogenous constituents of the animal food, on account of their close relation to the formation of blood and flesh, the plastic constituents of the food, and considered them the source of animal energy, or interior and exterior phenomena of motion.

II. Non-Nitrogenous Constituents of Food.

(As starch, sugars, organic acids, cellular substance, dextrine, gums, fats, etc.)

The composition and the general character of some of the principal non-nitrogenous organic plant constituents, and their relation to the animal economy, engaged Liebig's attention not less than that of the nitrogenous substances.

Many organic substances, which did not contain nitrogen, had already been studied with more or less success by other chemists, before Liebig turned his scientific efforts towards the application of chemistry in the study of animal physiology.

The elementary composition of the starch, the sugars, the fats, the principal organic acids, cellular substances, etc., was known; all consisted of but three elements — carbon, hydrogen, oxygen.

The fats of plants and of animals had been carefully studied by Cheuvoreal and others; it had been proved that they are composed of the same constituents, and that they are in every way identical. The changes of the starch and the vegetable cellular mass into sugar by the aid of mineral acids, and of the sugar into carbonic acid and alcohol by means of some nitrogenous organic matter, had been described. Liebig's main efforts in this connection were directed towards the study of the origin and the functions of the fat in the animal system.

But little attention had been thus far paid to the solution of these questions.

The animal fat was still considered a kind of stored up food, which in time of need would support life in consequence of an assumed disposition to combine with the nitrogen of the air, forming thereby nitrogen containing animal matter, like blood and flesh. Liebig, for obvious reasons, discarded these opinions. His own experience induced him to teach, as far as the origin of the fat in the animal system was concerned, that quite frequently a large proportion of the animal fat was produced in the animal, and not merely derived from the vegetable food it had consumed. He did not deny that the fat contained in the latter was absorbed

during the process of digestion, without any material change in its general character; he simply ascribed to the animal organism the power to convert, not only substances like starch and sugar, but also nitrogenous compounds, into neutral animal fats.

Practical observations as well as scientific considerations furnished the arguments for his views. The large accumulation of fat noticed in well-fed cattle, sheep, pigs, and fowls could hardly be ascribed to the amount of fat found in the food consumed. Men living largely on a diet rich in starch and in sugar, as a rule, are more apt to accumulate fat than those living mainly on meat. On the other hand, the peculiar action of the saliva on starch, changing it into sugar, and of certain nitrogenous substances on the latter, changing the sugar into acids found in natural fats, besides the well-known degeneration of muscles and flesh parts of the animal body, into fat, rendered it quite probable that similar agencies operating in the animal system could produce the animal fats from non-nitrogenous, as well as from nitrogenous, constituents of the vegetable food consumed.

These teachings of Liebig were at first received with much opposition, yet they are to-day still held worthy of the most serious consideration. The subsequent careful investigations of Dumas, Persoz, Bousingault, Lawes and Gilbert, and others, confirm the insufficiency of the fats contained in the food consumed, to account for the exceptionally large accumulation of fat in many successful and economical cases of stock fattening.

The same experimenters recognize also the beneficial influence of a liberal supply of nitrogenous food wherever an alteration of starch or sugar into fats has to be assumed to explain an exceptional accumulation of that substance in the animal system. One of the best authorities in practical stock feeding of to-day (J. Kühn) states without reserve, in his late advice to farmers, that wherever the fodder contains a liberal supply of starch or of sugar, they may be considered an offset for a deficiency in fat.

The real weakness in Liebig's views regarding the origin of fats in animals consists more in the fact that we are not yet able to give a satisfactory explanation regarding the precise

chemical or physiological process which changes the free, fatty acids produced from starch and sugar into the neutral fats (glycerides, *i. e.*, combination of the well-known substance, glycerine), than that practical experience disproves the assumptions. Physiologists and physiological chemists of to-day recognize almost without exception the important relations which exist between a liberal supply of sugar and starch in the animal diet and the actual accumulation of fat in the animal system; yet they differ more or less as far as their special mode of action is concerned. Some investigators believe with Liebig, for good scientific reasons, in a direct conversion of sugar and starch into animal fat, leaving the actual proof confidently to future developments. Others deny the actual change of both substances into animal fat; they ascribe to them merely the functions of protecting the fat contained in the fodder, and the fat produced from the nitrogenous constituents of the vegetable food whilst passing through the animal system against the oxydizing influence of the air during the process of respiration. (Voit.)

The beneficial influence of a rich nitrogenous diet on the products of the dairy is frequently mentioned as a substantial proof in that direction.

All non-nitrogenous constituents of the food, the fat included, yield to the oxydizing influence of the air and produce the same compounds, namely, carbonic acid and water, whether burned in the open air, or during their circulation through the animal body. As they support the process of respiration, Liebig called them the respiratory or heat-producing constituents of the animal food; he ascribed the entire production of the organic animal heat to a chemical process, and assigned to the non-nitrogenous substances no other ultimate functions but to produce heat: the amount of carbonic acid and water produced became the direct expression of the consumption of oxygen from the air during the process of respiration.

These statements are to-day still considered satisfactory in their general application. Chemical reactions are considered the source of animal heat and of animal energy.

III.—Mineral Constituents of the Food.

(Lime, Potassa, Soda, Magnesia, Iron, Sulphur, Phosphorus, Chlorine, etc.)

The relations of the mineral constituents of the animal body to the life of animals were not better understood before 1840 than those found in plants to the life of plants. Liebig's well-known extensive investigations concerning the functions of certain mineral substances in the growth of plants, induced him to study their relations to animal life. He compared the mineral constituents of the food consumed with those found in the animal body; he studied the distribution of the various mineral elements throughout the different organs of the body and within the secretions and the excretions of the animals on trial. In the course of these investigations he noticed the alkaline reaction of the blood, found the soda the principal alkali in the blood and in the bile, and the potassa in the flesh, and recognized the hydrochloric acid as a constituent of the liquid of the stomach.

These and similar important results caused him to assert, for the first time in the history of animal physiology, that a definite supply of certain mineral substances is indispensable for the continuation of life. His special views may be gleaned from the following personal statement.

"The inorganic or saline substances which form the constant constituents of the blood, of the flesh, of the muscles and of every other organ, exert an important and, in many instances, even a controlling influence on the process of animal respiration, digestion, assimilation, secretion and excretion. They impart to the organic portion of the food, the power of supporting animal life; without them no food is complete."

Actual experience has fully confirmed his statements. To feed merely the mineral constituents of the fodder articles is equal to starvation, and to deprive the normal animal food of its essential mineral constituents before feeding it carries with it the destruction of life wherever such material is exclusively fed. Judging from experience in plant growth, it seems but reasonable to assume that in compounding fodder rations for our various kinds of farm animals the mineral

constituents of the fodder should be properly supplemented, if necessary, to meet the special wants of the animal.

The previous short sketch of Liebig's experimental investigations regarding the requirements of a complete animal diet cannot fail to show that his demonstration of the necessity to compound fodder rations with reference to three distinctly differing groups of plant constituents has given us a more concise idea concerning the process of animal nutrition, and thereby furnished us with a safer basis for studying the feeding effect of our farm crops.

The extensive practical chemical work which has furnished him with the material for his conclusion regarding the process of animal digestion, assimilation, respiration, etc., and the dependency of the animal food on the constituents of plants, is largely due to the careful scientific labors of many other eminent scientists; the comprehensive interpretation of their results are essentially his own.

Chemical physiology, as a distinct field of scientific research, originated with Liebig; yet it is equally true that some of the first and of the most important chemical physiological investigations are due to distinguished pioneers in comparative anatomy and modern physiology, — J. V. Müller and others, contemporaries of him.

A characteristical statement of Liebig regarding the relation which exists between the vegetable and the animal kingdom may close this chapter.

"A comprehensive law of nature connects the development of the organs of an animal, its growth and its increase in weight with the consumption of certain substances, which are identical with the principal constituents of its blood; it is manifest that the animal organism produces its blood only as far as its form is concerned; and, also, that nature has denied to it the power to produce it out of other substances, which are not identical with the principal constituents of its blood.

"The animal body is a higher organism, which begins its development with those materials with which the life of the ordinary fodder plant usually terminates. As soon as the fodder crops and the grain crops have produced their seeds, they die; with the production of the fruit, a period of life in the case of the perennial plant ends; in the innumerable

series of organic compounds, which begin with the inorganic articles of plant food, to the most complicated constituents of the brain of the animal, we cannot notice a break nor an interruption. The constituent of the animal food, which produces the principal part of its blood, is the product of the vital activity of the plant."

Having attempted in preceding pages to show the important influence which chemistry has exerted on the development of a more concise idea of what constitutes a complete article of animal diet, from a physiological standpoint, *i. e.*, regarding its special fitness to sustain the life of animals, I propose to point out briefly the effect which the above-stated information has had on the rational agricultural practice of to-day.

The recognition of the physiological fact, that no single constituent of a plant can support animal life for any length of time, — neither nitrogenous matter, nor fat, sugar or starch, nor mineral matter; but that certain proportions are required of each of the three principal groups of substances previously described, induced chemists to study more closely the various farm plants with particular reference to the relative proportion, and to the special quality of their proximate constituents.

The results obtained in this connection soon revealed the fact, that not two kinds of plants, or even parts of plants, are of an identical composition. It became soon apparent that the composition of one and the same plant even differs widely not only at the various stages of growth and maturity, but also when raised in a different climate and upon a different kind of soil, as well as in case of a varying system of manuring and of cultivation. Whilst it could not be denied that the character and the quality of each farm plant became soon much better known, and that actual feeding experiments carried on with a due consideration of a more exact chemical examination of the particular kind of fodder consumed, had afforded a safer basis for final conclusions, it became not less evident, in the course of time, that the chemical analysis of an article of fodder alone did not suffice to decide the comparative feeding value of different kinds of farm plants, or even of the same plants in different stages of

growth. The chemical analysis of the time had furnished most valuable information regarding the general character of many of our fodder plants as far as the quality and the quantity of their proximate organic constituents are concerned, yet it had not given all the information needed to pronounce upon their exact feeding value.

As only that part of the food consumed can participate in the process of animal nutrition, which, by the aid of the secretion of the digestive organs enters into solution and subsequent circulation through the animal system, it is but natural that the rate of digestibility of our prominent farm crops in various stages of growth, as well as in case of various kinds of farm animals, could not fail to engage the attention of agricultural chemists.

They directed their efforts in two directions:

First, they improved their mode of analyzing fodder substances. The alterations were made with a view to secure analytical results which would closer correspond with the rates of digestibility noticed in actual feeding experiments. Since 1860, one mode has been used in the majority of fodder analyses (Henneberg, Stohmann, Heiden). The advantage of this course consists in the fact that all analyses since that year have a strictly comparative value, as far as the new results are concerned.

Second, new feeding experiments were carried on with the direct purpose to ascertain by competent hands the actual transformation which the different constituents of the fodder plants suffered by their passage through the system of different kinds of farm stock.

A lately published compilation of carefully conducted feeding experiments (E. Wolff in Mentzel's and Lengerke's Kalender 1882, I Bd. '83) shows that one hundred and eighty-two articles of fodder have thus far been tested, regarding their digestibility; seventy-eight experiments were carried on with cattle, three hundred and ninety-four with sheep, twenty with goats, thirty-five with horses, and four to five with swine. The subsequent tabular statement of feeding experiments by Julius Kühn in Halle, 1880, is not without interest in this connection as a matter of reference.

The first table contains the analyses of the different articles of fodder fed during the experiments recorded in the second table. The highest and the lowest results of their analyses are stated for the particular purpose of calling the attention of practical farmers to the important fact that the quality of their crops deserves the most serious consideration in a rational system of stock-feeding. The influence of the condition of the lands, as far as manuring is concerned, and the particular system of cultivation on the composition of the crops, is far more serious than generally assumed.

The second table (page 110) states the rates of digestibility, in percentages, of each group of essential constituents of the fodder articles which served in the recorded experiments. The highest and the lowest rates are stated, to convey some approximate idea regarding the influence which the condition of the fodder and the individuality of the animal may exert on the digestibility of the particular constituents of the former.

I.—*Percentage of the Composition of Food Materials, with which Experiments have been Made on Animals, to Determine their Digestibility.*

KIND OF FOOD MATERIAL.	DRY SUBSTANCE AFTER REMOVAL OF MOISTURE.			ALBUMINOIDS.			FAT-OIL.			CARBO-HYDRATES.			WOODY FIBRE.			ASH.
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Average.
I.—GREEN FOODS.																
1. Meadow grass,	22.0	40.5	29.2	1.9	4.0	2.6	0.3	1.1	0.70	8.4	15.4	11.7	7.00	16.3	12.1	2.1
2. Pasture grass,	12.4	48.1	25.0	1.6	6.0	3.0	0.3	1.5	0.80	3.5	22.8	13.1	3.12	17.0	6.0	2.1
3. Clover from pasture,	16.4	20.3	19.8	3.5	4.5	4.0	0.8	0.9	0.85	7.2	9.8	8.0	5.20	6.0	5.6	1.4
4. Clover,	13.6	31.9	19.8	2.2	6.2	3.6	0.4	1.6	0.70	4.2	15.1	8.5	3.40	11.0	5.6	1.4
5. Lucerne,	16.5	30.1	21.7	2.8	7.3	4.5	0.5	0.9	0.70	6.0	14.4	8.4	3.5	13.4	9.3	1.8
6. Sainfoin,	20.0	23.4	21.5	3.2	4.3	3.5	0.6	0.9	0.70	8.2	10.8	8.5	5.8	12.9	7.6	1.2
7. Common vetch,	15.7	19.4	18.0	2.7	1.7	3.7	-	-	0.60	4.5	12.7	6.1	3.9	10.0	6.0	1.6
8. Lupines,	10.6	16.1	11.3	2.4	4.2	3.1	0.2	0.4	0.30	4.0	7.3	6.2	1.4	5.1	4.0	0.7
9. Potato vines,	-	-	22.0	-	-	2.3	-	-	1.00	-	-	9.7	-	-	6.0	3.0

10. Fodder corn,	13.2	23.2	16.0	0.9	2.2	1.4	0.2	0.8	0.50	5.8	15.3	8.4	3.0	5.9	4.7	1.0
11. Sorghum,	15.9	37.1	28.7	2.5	5.9	1.1	0.8	1.5	1.10	6.0	16.2	12.1	4.6	11.6	9.2	1.9
12. Leaves of poplar,	34.2	45.0	38.9	2.8	8.0	5.2	-	-	1.50	5.2	33.1	15.2	6.0	22.9	13.0	4.0
II.— Varieties of Hay.																
13. Meadow hay,	78.3	90.2	85.7	5.8	19.4	9.5	1.2	5.6	2.3	22.6	50.7	10.3	19 7	39.9	27.1	6.5
14 Rowen,	79.8	88.2	85.7	8.4	18.5	11.7	2.3	6.8	3.1	33.3	49.7	12.3	19.0	30.7	22 0	6.6
15. Clover hay,	77.1	90.0	83 3	7.2	15 8	11.0	1.2	5.5	3.2	22.3	39.7	32.9	19.5	43.0	29.9	6.3
16. Lucerne hay,	80.8	87.5	83.8	13.1	19.7	11.4	2.3	3.8	2.5	20.0	34.8	27.9	19.3	40 0	33.0	6.0
17. Sainfoin hay,	83.3	88.2	85.1	12.8	17.1	13.3	-	-	2.5	31.2	34 7	34.5	27.1	30 9	29.0	5.8
18. Hay of common vetch,	83.3	85.7	85.1	14.2	20.4	17.6	2.1	2.50	2.3	28.5	32.8	29.7	23.5	29.5	26.5	9.0
19. Hay of lupines,	74.1	90.9	86.1	6 0	23.5	16.0	1.1	2.9	2.2	28.1	31 2	29.5	23.0	48.3	32.6	5.8
20. Dried potato vines,	85.0	95.3	90.0	5.7	12.9	9.4	1.2	3.6	2.4	33.0	38.6	31.6	22.7	36.6	32.0	11.6
21. Ensilage of beet leaves,	20.0	26.8	23 4	0.94	3.0	1.9	0.75	1.2	1.0	8.6	9.0	8.8	2.0	2.7	2.3	9.4
III.— Straw.																
22. Wheat straw,	74.0	91.9	85.7	1.4	5.6	3.1	0.6	2.0	1.2	26.1	44.4	37.5	28.9	52.6	40.0	3.9
23. Rye straw,	81.4	89.7	85.7	1.5	4.6	3 0	1.1	2.5	1.3	23.4	41.5	33.3	30 1	51.9	44.0	4.1
24. Oat straw,	78.8	89.7	85.7	1.3	7.0	4.0	1.0	5.1	2.0	24.9	48.9	35.6	30.0	50 2	39.7	4.4
25. Barley straw,	82.5	89.1	85.7	1.9	5.4	3.4	1.1	2.04	1.4	18.2	45.5	31.7	31.4	54.0	41.8	4.1

Percentage of the Composition of Food Materials — Continued.

KIND OF FOOD MATERIAL.	DRY SUBSTANCE AFTER REMOVAL OF MOISTURE.			ALBUMINOIDS.			FAT-OIL.			CARBO-HYDRATES.			WOODY FIBRE.			ASH.
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Average.
26. Bean straw,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 and 28. Pea straw,	78.0	85.5	82.5	3.3	16.4	9.9	0.7	2.2	1.5	16.9	33.8	31.8	25.8	41.7	33.5	5.8
28. Lupine straw,	85.8	89.7	87.4	4.9	6.2	5.5	1.1	1.5	1.3	33.2	35.6	34.2	37.5	40.9	39.5	5.3
IV. — GRAINS.																
29. Oats,	83.6	92.1	86.3	6.3	18.5	12.0	4.4	7.3	6.0	48.0	71.8	56.6	4.1	16.1	9.0	2.7
30. Barley,	79.1	91.7	86.2	6.2	18.3	11.2	1.0	3.2	2.1	56.1	74.7	65.5	2.2	10.8	5.2	2.2
31. Corn,	77.6	91.8	87.3	5.8	15.1	10.6	1.5	9.2	6.5	52.4	72.7	65.7	1.3	8.5	2.8	1.7
32. Beans,	80.3	88.3	85.9	21.4	28.2	25.1	1.2	2.5	1.6	42.8	55.4	46.7	3.7	12.6	9.4	3.1
33. Pease,	77.9	91.1	86.8	18.6	27.1	22.4	0.6	5.3	3.0	41.9	59.6	52.6	1.9	9.2	6.4	2.4
34. Lupines,	82.4	90.6	87.2	28.3	13.4	35.4	3.7	7.9	5.3	20.2	36.4	29.2	11.4	17.5	13.8	3.5
V. — TECHNICAL PRODUCTS AND BY PRODUCTS.																
35. Rapeseed cake,	80.8	98.2	88.5	17.9	45.5	31.6	4.4	18.8	9.6	7.4	41.6	29.3	1.3	28.4	11.0	7.0

36. Linseed cake,	81.1	92.9	87.8	20.6	37.8	29.5	6.0	18.2	10.0	19.7	41.3	29.8	5.1	16.8	9.7	8.8
37. Palm-nut meal,	81.9	93.4	89.2	11.7	23.9	18.5	1.1	7.3	3.3	22.4	52.5	41.7	11.7	39.7	21.7	4.0
38. Palm-nut cake,	85.6	93.3	89.5	10.7	21.7	16.9	6.8	29.3	12.0	17.9	52.0	39.0	9.9	30.7	17 4	4.2
39. Cocoanut cake,	87.9	91.0	90.6	16.3	37.2	20.6	6.9	22.7	13.2	28.4	47.4	37.4	7.5	21.1	14.2	5.2
40. Cotton-seed cake.	85.8	93.4	90.0	18.2	28.3	23.5	5.1	9.8	6.6	26.5	36.7	32.0	17.0	27.0	21.1	6.8
41. Wheat bran,	83.5	92.4	87.0	10.1	27.0	14 5	1.7	6.6	3.5	28.5	61.5	53.6	4.1	31.6	9.4	6.0
42. Spelt bran,	86.0	87.0	86.5	13.8	16.1	11.6	3.0	5.3	4.1	51.6	51.9	53.3	8.1	9.8	8.9	15.6
43. Rye bran,	81.6	93.5	87.5	10.1	18.1	14.5	1.9	5.0	3.5	32.9	61.6	57.1	4.2	28.5	7.2	5.2
44. Skimmed milk (sour),	7.6	11.5	10.0	2.5	4.9	3.5	0.3	1.4	0.7	3.1	6.1	5.0	-	-	-	0.5
45. Meat flour,	86.4	90.9	88.5	46.0	74.7	72.8	1.2	13.2	12.0	-	-	-	-	-	-	3.7
46. Norwegian fish-guano,	-	-	87.4	-	-	49.0	-	-	1.8	-	-	-	-	-	-	36.6
47. May bogs,	-	-	99.6	-	-	18.8	-	-	3.7	-	-	-	-	-	4.8	6.7

II. — *Digestibility of Fodder Plants and of Technical Products Actually Experimented with.*

THE DIGESTIBLE COMPONENT PARTS IN PER CENT.

KINDS OF FOOD MATERIAL.	Albuminoids.			Fat or Oil.			Carbo-hydrates.			Woody Fibre.		
	Lowest.	Highest per-centage.	Average.	Lowest.	Highest per-centage.	Average.	Lowest.	Highest per-centage.	Average.	Lowest.	Highest per-centage.	Average.
I. — Green Foods.												
1. Meadow grass,	70.6	79.3	75.0	63.4	68.1	66.0	74.5	84.4	79.0	70.3	75.2	73.0
2. Pasture grass, good quality,	69.0	71.7	70.0	60.4	68.1	65.0	74.7	84.4	79.0	65.4	72.8	69.0
3. Clover from pasture,	77.7	78.7	78.0	63.3	65.1	64.0	78.0	78.5	78.0	66.9	67.4	67.0
4. Clover, red variety, shortly before flowering,	70.5	74.3	73.0	57.0	65.2	62.0	69.6	83.2	76.0	50.1	60.4	55.0
4. Clover, red variety, at the beginning,	71.7	76.3	74.0	66.1	75.3	71.0	73.0	80.1	77.0	52.2	59.2	56.0
4. Clover, red variety, in full bloom,	64.7	70.2	67.0	58.6	65.4	63.0	68.3	72.6	70.0	46.4	50.1	48.0
4. Clover, red variety, at the end,	56.4	60.8	59.0	42.2	46.7	45.0	70.3	71.0	71.0	38.3	39.3	39.0
5. Lucerne (before and at beginning of flowering),	78.2	83.2	81.0	37.0	53.6	45.0	61.1	76.9	72.0	31.6	46.8	41.0
6. Sainfoin,	71.7	73.3	73.0	64.1	69.2	67.0	76.5	80.0	78.0	42.1	42.3	42.0
7. Common vetch,	73.0	80.0	76.0	50.0	65.8	60.0	63.3	76.3	65.0	51.2	58.3	54.0
8. Lupines,	73.0	75.7	74.0	15.5	45.3	30.0	57.3	65.9	62.0	67.1	79.8	73.0
9. Potato vines, beginning of October,	-	-	42.0	-	-	24.0	-	-	60.0	-	-	36.0
10. Fodder corn,	-	-	73.0	-	-	75.0	-	-	67.0	-	-	72.0

11. Sorghum,	–	–	62.0	–	–	85.0	–	–	78.0	–	–	60.0
12. Leaves of poplar,	–	–	56.0	–	–	79.0	–	–	65.0	–	–	35.0
II. — VARIETIES OF HAY.												
13. Meadow hay,	38 9	71.0	57.0	8.5	69.7	46.0	48.0	78.8	63.0	44.6	72.4	58.0
14. Grummet,	53.0	68.0	61.0	27.0	57.4	46.0	56.7	75.0	66.0	54.3	74.9	63 0
15. Clover hay,	43.0	73.3	60.0	33.0	75.3	59.0	62.5	80.1	69.0	38.0	59.2	47.0
16. Lucerne hay, excellent quality,	72.1	83.0	77.0	29.7	51.0	39.0	52.6	72.0	65.0	33.1	45.7	40.0
17. Sainfoin hay (very carefully dried),	69.7	70.2	70.0	65.1	67.4	66.0	73.6	75.0	74.0	33.3	39.1	36.0
18. Hay of common vetch,	73.0	80.0	76.0	50.0	65.8	60.0	63.3	67.3	65.0	51.2	58.3	54.0
19. Hay of lupines,	73.0	75.7	74.0	15.5	45.3	30.0	57.3	65.9	62.0	67.1	79.8	73.0
20. Dried potato vines,	–	–	42.0	–	–	21.0	–	–	60.0	–	–	36.0
21. Ensilage of beet leaves,	–	–	65.0	–	–	60.0	–	–	54.0	–	–	54.0
III. — STRAW.												
22. Wheat straw,	–	–	26.0	–	–	27.0	–	–	40.0	–	–	52.0
23. Rye straw,	2.6	82.6	25.0	21.2	40 9	32.0	28.5	51.8	36.0	46.8	72.9	56.0
24. Oat straw,	14.4	50.0	38.0	14.0	51.0	30.0	32.2	47.0	42.9	53.0	67.0	61.0
25. Barley straw (poor quality),	12.8	16.8	15.0	32.4	42.6	38.0	50.7	51.3	51.0	49.1	55.6	52.0
26. Bean straw,	49.0	55.0	51.0	50.0	60.0	55.0	57.0	64.0	61.0	33.0	39.0	36.0
27. Pea straw (very good),	60.3	60.6	60.5	41.6	50.1	46.0	64.0	64.8	64.0	47.2	55.9	52.0
28. Lupine straw,	35 4	39.7	37.0	25.4	35.0	30.0	64.5	65.1	65.0	49.2	52.0	51.0

Digestibility of Fodder Plants and of Technical Products, etc. — Concluded.

KINDS OF FOOD MATERIAL.	Albuminoids.			Fat or Oil.			Carbo-hydrates.			Woody Fibre.		
	Lowest.	Highest per-centage.	Average.	Lowest.	Highest per-centage.	Average.	Lowest.	Highest per-centage.	Average.	Lowest.	Highest per-centage.	Average.
IV. — Grains.												
29. Oats (tested on ruminants),	58.0	81.3	74.0	68.4	99.0	82.0	65.0	79.7	73.0	5.5	32.1	21.0
30. Barley (ground, tested on ruminants),	-	-	77.0	-	-	100.0	-	-	87.0	-	-	20.0
Barley (ground, tested on pigs),	74.6	80 7	78.0	58.2	77.3	69.0	89.3	91.3	90.0	14.4	27.4	20.0
31. Corn (ground, tested on pigs),	83.9	88.1	85.0	74.4	78.5	76.0	92.5	93.3	94.0	17.0	57.4	34.0
32. Beans (ground, tested on ruminants),	80.6	100.0	90.0	86.9	100.0	97.0	90.7	98.7	94.0	25.1	100.0	63.0
33. Pease (only tested on pigs),	84.4	91.5	88.0	45.0	69.0	58.0	91.7	98.6	97.0	55.1	88.5	74.0
34. Lupines (tested on sheep),	95.5	97.6	97.0	-	-	100.0	77.0	100.0	90.0	-	-	-
V. — Technical Products, etc.												
35. Rapeseed cake (tested on cows and steers),	81.3	92.4	85.4	79.7	93.6	88.0	70.2	84.9	78.0	0.0	34 3	11 0
The same (tested on sheep),	65.3	83.9	75.9	59.8	77.2	69.0	66.0	85.4	78.0	0.0	5.5	3.0
36. Linseed cake (tested on steers),	80.2	89.9	87.0	86.7	93.9	91 0	85.0	96.3	91.0	-	54.5	26.0
The same (tested on goats and sheep),	80.0	87.4	83.0	86.5	92.5	90.0	60.0	78.7	71.0	29.7	92.9	62.0
37-38. Palm-nut meal and palm-nut cake (tested on ruminants),	95.0	100.0	98.0	95.0	100.0	98.0	92.0	96.0	94.0	72.2	92.0	82,0

39. Cocoanut cake (tested on pigs),	72.7	74.2	74.0	81.8	84.6	83.0	87.3	81.2	89.0	54.7	66.0	60.0
40. Cotton seed cake (tested on sheep),	69.4	78.0	74.0	83.3	100.0	91.0	37.6	54.7	46.0	7.1	36.2	23.0
41. Wheat bran (dry, fed to steers),	82.9	93.5	88.0	77.6	81.6	80.0	77.7	81.2	80.0	16.9	32.2	20.0
The same variously prepared — boiled, fermented, etc. (fed to steers),	61.6	81.0	70.0	68.8	89.9	81.0	69.7	82.4	75.0	3.5	21.5	13.0
The same (tested on sheep),	-	-	75.0	-	-	50.0	-	-	70.0	-	-	37.0
42. Spelt bran (tested on sheep),	65.5	85.2	73.0	81.3	93.8	88.0	81.3	100.0	91.0	1.21	100.0	?
43. Rye bran (tested on pigs),	65.8	66.2	66.0	57.4	57.6	57.5	74.7	74.5	74.5	6.5	10.5	9.0
44. Skimmed milk, sour (tested on pigs),	-	-	96.0	-	-	95.0	-	-	99.0	-	-	-
45. Meat flour (tested on ruminants),	-	-	95.0	-	-	98.0	-	-	-	-	-	-
The same (tested on pigs),	95.1	98.9	97.0	82.3	90.7	87.0	-	-	-	-	-	-
46. Norwegian fish-guano (tested on ruminants),	-	-	90.0	-	-	76.0	-	-	-	-	-	-
47. May-bogs (tested on pigs),	70.9	81.0	77.0	78.8	91.8	83.0	-	-	-	-	-	-

These tabular statements show that the particular stage in the growth of a fodder plant exerts not only a controlling influence on its composition, but also on the rate of digestibility of its various organic constituents; and they prove also that the same group of organic constituents behave differently in that direction, not only in case of different plants, but also in case of different parts of the same plant. A few observations may illustrate these facts: —

1. Rate of Digestibility of Nitrogenous Constituents.

	Per cent.		Per cent.
Corn,	85	Oats,	74
Wheat bran,	70	Rye bran,	66
Wheat straw,	26	Oat straw,	38
Meadow hay,	57	Rowen,	61
Green maize,	73	(Stover,	26?)
Green clover, just before blooming,			73
Green clover, in full bloom,			67
Green clover, at the close of blooming,			59

2 Rate of Digestibility of Fats.

	Per cent.		Per cent.
Corn,	76	(Stover,	28?)
Oats,	82	Oat straw,	30
Barley,	100	Wheat straw,	27
Green corn,	75		

3. Rate of Digestibility of Non-nitrogenous Extract Matter.

	Per cent.		Per cent.
Corn,	94	Green corn,	67
Oats,	73	(Stover,	40?)
Potatoes,	100		

4. Rate of Digestibility of Crude Vegetable Fibre.

	Per cent.		Per cent.
Corn,	34	Stover,	52
Oats,	21	Oat straw,	61
Barley,	20	Barley straw,	52

(Cattle, 70 per cent., horses, 25 per cent., swine, 10 per cent.)*

Adding to these results the facts, that these rates of digestibility vary more or less in case of different kinds of animals, it is quite obvious, that no single plant can furnish a proper standard for the valuation of the various fodder sub-

* Approximations.

stances, nor can one definite number state correctly their relative feeding value. A former practice of agriculturists to consider a good meadow hay the standard crop for a determination of the relative or absolute feeding value of other crops rests largely on a misconception, for it confounds the market price of the article with its feeding value.

The value of an article of fodder may be stated from two distinctly different standpoints, namely:

1. From an economical standpoint, its cost or market price; and

2. From a physiological standpoint, its feeding effect or nutritive value.

I. The market price of our fodder articles depends on the supply and the demand in the general market; its determination is beyond the control of the individual farmer. The market price of hay of the same quality may vary widely in different years and in different localities; its feeding value remains materially the same, under corresponding circumstances, year after year.

The chemical analysis of fodder crops has been turned to account to ascertain their comparative approximate market value in a similar way as the analysis of commercial fertilizers, by assigning to each class of their principal food constituents, as far as their digestible portion is concerned, a value deduced from its costs in a leading fodder crop of a good average quality. The ton price in principal depots serves best for that purpose, and the calculated price refers to similar market conditions; the proper retail price may be best determined in each locality with proper consideration of its facilities of market, transportation, etc. This practice, which has been of late introduced into Germany, has the advantage of telling us whether any particular lot of a fodder article is cheap or not, at the price we are asked for it, and whether the present price of a commercial article of fodder is a fair one or an extraordinary one; it also can teach us, after a careful consideration of our home resources of fodder, what particular commercial fodder material would best supplement our stock of fodder on hand, to benefit our special farm industry. According to present rules ,nitrogenous fodder constituents and fat are counted about five

times as high as the non-nitrogenous extract matter and the digestible cellulose substance. German agricultural chemists allow four and one-third cents per pound of digestible nitrogenous food constituents and fat, and nine-tenths of a cent per pound of digestible non-nitrogenous extract matter and cellular substance. Whether this basis will prove to be the most judicious one for our circumstances, experience will soon decide; for my present purpose, namely, to illusrate the application of the chemical analysis as a means to ascertain the relative, comparative money value of several varieties of corn, etc., the German values are applicable:

I.	Canada Dutton Corn,	$1.13¾	per 100 lbs.
II.	Canada Dutton Corn,	1.09¾	"
III.	Crosby Sweet Corn,	1.15¾	"
IV.	Blue Texas Sweet Corn,	1.24¾	"
V.	Wheat Bran (shorts),	21.04	per ton.
VI.	Canada Dutton Corn,	22.13	"
VII.	Cotton-Seed Cake,	–	
	Decorticated,	39.29	per ton.

I.—*Canada Dutton Corn, No. 1.*

	Moisture.	Fat.	Nitrogenous Matter. (Albuminoids.)	Non-Nit. Extract Matter.	Cellulose.	Ash.
Digestible Ratio,	–	76 pr. ct.	85 pr. ct.	94 pr. ct.	34 pr. ct.	–
Value per lb.,	–	4⅓ cents.		.9 cent.		–
100 lbs.,	15.0000	4.4835	11.7954	65.0985	2.3602	1.2664
Digestible,	–	3.409	10.030	61.195	.80	–
75 lbs.,	11.2500	3.3627	8.8467	48.8238	1.7703	.9498
Digestible,	–	2.5560	7.5225	45.8970	.60	–
50 lbs.,	7.5000	2.2418	5.8978	32.5492	1.1802	.6332
Digestible,	–	1.7040	5.0150	30.5980	.40	–
25 lbs.,	3.2500	1.1209	2.9489	16.2746	.5901	.3166
Digestible,	–	.8520	2.5075	15.2990	.20	–
Actual value of digestible matter in 100 lbs.		15 cts.	43 cts.	55 cts.	¾ ct.	
		Total,—$1.13¾ per 100 lbs.				

II. — *Canada Dutton Corn, No. 2.*

Digestible Ratio,	-	76 pr. ct.	85 pr. ct.	94 pr. ct.	34 pr. ct.	-
Value per lb.,	-	4⅛ cents.		.9 cent.		-
	Moisture.	Fat.	Nitrogenous Matter (Albuminoids.)	Non-Nit. Extract Matter.	Cellulose.	Ash.
100 lbs.,	15.0000	4.9600	10.2445	66.0840	2.3602	1.3513
Digestible,	-	3.7680	8.7200	62.1160	.80	-
75 lbs.,	11.2500	3.7200	7.6833	49.5630	1.7703	1.0134
Digestible,	-	2.826	6.5400	46.5870	.60	-
50 lbs.,	7.5000	2.4800	5.1222	33.0420	1.1802	.6756
Digestible,	-	1.8840	4.3600	31.0580	.40	-
25 lbs.,	3.7500	1.2400	2.5611	16.5210	.5901	.3378
Digestible,	-	.9420	2,1800	15.5290	.20	-
Actual value of digestible matter in 100 lbs.		15 cts.	37½ cts.	56 cts.	¾ ct.	
		Total,—$1.09¼ per 100 lbs.				

III.— *Crosby Sweet Corn.*

Digestible Ratio,	-	76 pr. ct.	85 pr. ct.	94 pr. ct.	34 pr. ct.	-
Value per lb.,	-	4⅛ cents.		.9 cent.		-
	Moisture.	Fat.	Nitrogenous Matter (Albuminoids.)	Non-Nit. Extract Matter.	Cellulose.	Ash.
100 lbs.,	15.0000	6.4372	10.8096	63.7984	2.3155	.6394
Digestible,	-	4.8900	9.1900	60.0600	.7	-
75 lbs.,	11.2500	4.8279	8.1072	47.8488	1.7367	1.2297
Digestible,	-	3.6600	6.9000	45.0500	.60	-
50 lbs.,	7.5000	3.2186	5.4048	31.8992	1.1578	.8198
Digestible,	-	2.4100	4.6000	30.0400	.40	-
25 lbs.,	3.7500	1.6093	2.7024	15.9496	.5789	.4099
Digestible,	-	1.2200	2.3000	15.0200	.20	-
Actual value of digestible matter in 100 lbs.		21 cts.	40 cts.	54 cts.	¾ ct.	
		Total,—$1.15¾ per 100 lbs.				

IV. — *Blue Texas Sweet Corn.*

Digestible Ratio,	-	76 pr. ct.	85 pr. ct.	94 pr. ct.	34 pr. ct.	-
Value per lb.,	-	4⅓ cents.		.9 cent.		-

	Moisture.	Fat.	Nitrogenous Matter (Albuminoids.)	Non-Nit. Extract Matter.	Cellulose.	Ash.
100 lbs.,	15.0000	8.0156	12.7645	60.4038	2.3602	1.4559
Digestible,	-	6.0920	10.8520	56.7530	.80	-
75 lbs.,	11.2500	6.0117	9.5733	45.3030	1.7703	1.0920
Digestible,	-	4.5690	8.1390	42.5640	.60	-
50 lbs.,	7.5000	4.0078	6.3822	30.2020	1.1802	.7280
Digestible,	-	3.0460	5.4260	28.3760	.40	-
25 lbs.,	3.7500	2.0039	3.1911	15.1010	.5901	.3640
Digestible,	-	1.5230	2.7130	14.1880	.20	-
Actual value of digestible matter in 100 lbs.		26 cts.	47 cts.	51 cts.	¾ ct.	
		Total,—$1.24¾ per 100 lbs.				

V. — *Nutritive Ratio, 1 : 4.14.*

Shorts or Wheat Bran. (Average analysis.)	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Value per ton 2,000 lbs.
Water,	15.0000	300.00	-	-
Fat,	3.4195	68.39	54.71	$2.37
Nitrogenous matter,	14.1667	283.33	249.33	10.80
Non-nitrogenous extract matter,	52.3678	1047.35	837.88	7.54
Cellulose,	9.1839	183.68	36.73	.33
Ash,	5.8621	117.25	-	-
	100.0000 pr. ct.	2000.00 lbs.	1178.65 lbs.	$21.04

	Fat.	Nitrogenous Matter.	Non-nitrogenous Matter.	Cellulose.
Digestible ratio,	80 per cent.	88 per cent.	80 per cent.	20 per ct.
Value per lb.,	4⅓ cents.		.9 cent.	

VI. — *Nutritive Ratio, 1 : 8.3.*

Canada Dutton Corn, No. 2.	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Value per ton 2,000 lbs.
Water, ...	15.0000	300.00	-	-
Fat, ...	4.9600	99.19	75.39	$3.27
Nitrogenous matter, .	10.2145	204.89	174.15	7.54
Non-nitrogenous extract matter, . . .	66.0840	1321.68	1242.37	11.18
Cellulose, . . .	2.3602	47.22	16.06	.14
Ash, ...	1.3513	27.02	-	-
	100.0000 pr. ct.	2000.00 lbs.	1507.97 lbs.	$22.13

	Fat.	Nitrogenous Matter.	Non-nitrogenous Matter.	Cellulose.
Digestible ratio, . .	76 per cent.	85 per cent.	91 per cent.	34 per ct.
Value per lb., . . .	$1\frac{1}{3}$ cents.		.9 cent.	

VII. — *Nutritive Ratio, 1 : 1.57.*

Cotton Seed Meal. (Decorticated.)	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Value per ton 2,000 lbs.
Water, ...	15.00	300.00	-	-
Fat, ...	13.11	262.20	235.40	$10.20
Nitrogenous matter, .	37.14	742.80	598.60	25.94
Non-nitrogenous extract matter, . . .	18.66	373.20	350.20	3.15
Cellulose, . . .	8.82	176.40		
Ash, ...	7.27	145.40	-	-
	100.00 pr. ct.	2000.00 lbs.	1184.20 lbs.	$39.29

	Fat.	Nitrogenous Matter.	Non-nitrogenous Matter.
Digestible ratio, . .	90 per cent.	81 per cent.	64 per cent.
Value per lb., . . .	$4\frac{1}{3}$ cents.		.9 cent.

II. The Physiological or Nutritive value of an article of Food refers to its actual Feeding effect.

The market value and the actual feeding effect of one and the same article do not *necessarily correspond* with each other; in fact, they *rarely coincide.*

The market value may be stated for each locality by one definite number. The feeding effect of one and the same substance, simple or compound, varies under different circumstances, and depends in a controlling degree on its judicious use. Sugar fed without any suitable admixture has no feeding value; it is worthless as the sole food of an animal. Properly supplemented — as, for instance, in the sweet corn — its nutritive value is very high. Bread has a high feeding value for man; a cat fed exclusively with bread dies, after some weeks, under the symptoms of starvation.

To compound the animal diet with reference to the *particular organization* of the *animal*, its *age* and its *functions*, is of no more importance than to select the fodder substances with reference to *its special wants*, as far as the *absolute* and *relative quantity* of the *three essential groups* of *food constituents* are concerned.

As no single plant or part of plant has been found to supply economically and efficiently to any considerable extent the wants of our various kinds of farm stock, it becomes a matter of first importance to learn how to supplement our leading farm crops, to meet the divers wants of each kind. To secure the highest feeding value of each article of fodder is most desirable in the interest of good economy. To try to attain that end by means of the products of home industry is a safe beginning. For this purpose it is desirable that we should learn to look upon a plant, or a part of a plant, not as a whole, but to pay more attention towards their composition. A little more acquaintance with the composition of our fodder crops, — as far as the relative and the absolute quantity of the three principal groups of essential constituents of an animal diet are concerned, — cannot fail to enable us to compound fodder rations for our stock on a more rational basis. A thorough information regarding the general character of the crops, and an approximately correct idea regard-

ing the chemical composition of the particular fodder on hand, are points of first importance when planning a rational and thus economical system of feeding for any particular kind of farm stock. A better knowledge of what we feed enables us to give a *more judicious explanation* of the results of our feeding experiments; it teaches us best, also, how to supplement our own fodder resources to meet the special wants of our farm stock.

Careful investigations in stock-feeding have taught us lessons similar to those we have learned to appreciate in feeding plants, or in the cultivation and the production of farm crops. All our farm plants need nitrogen, phosphoric and sulphuric acids, potassa, soda, lime, magnesia and iron; yet not two species of plants have been found which need the same quantity of these substances during their entire period of life, nor at any stage of their growth. No one of the above-stated essential mineral constituents of plants can replace another one to any extent without altering the character of the plant, or even endangering its life. Potassa cannot take the place of lime, nor phosphoric acid that of sulphuric acid. When lime is needed, a shovelful of that substance is worth more than any quantity of the many times more expensive potassa; that particular mineral element which supplies an actual want of the soil is, for this reason, from a physiological standpoint considered the most important one for the production of the plant; for without it the remaining essential mineral constituents of plants, whatever their quantity may be, cannot make them grow.

In regard to the growth and the support of our farm live-stock, similar relations have been noticed. Actual feeding experiments have shown that three groups of plant constituents (nitrogenous, non-nitrogenous, and mineral constituents) are required to sustain successfully animal life. No one or two of them, alone, can support it for any length of time. In case the food does not contain digestible non-nitrogenous substances, the fat and a part of the muscles of the animal on trial will be consumed in the support of respiration before its life terminates. In case nitrogenous constituents are excluded, the formation of new blood and flesh from the food consumed ceases, for the animal system is not

capable of producing their principal constituents from anything else than the nitrogenous constituents of the plants.

Herbivorous animals receive these substances directly from the plants; carniverous animals indirectly, by feeding on herbivorous animals. We feed at present our farm stock too frequently without a due consideration of the general natural law of nutrition; to deal out our fodder crops only with mere reference to name, instead of making ourselves more familiar with their composition and their particular quality, deprives us even of the chance of drawing an intelligent conclusion from our present system of feeding.

The peculiar character of our home-raised fodder articles is apt to conceal their special deficiency for the various purposes they are used for in a general farm management. They all contain the three essential food constituents, yet in widely varying proportions, and they ought, therefore, to be supplemented in different directions, to secure their full economical value. To resort to more or less of the same fodder article to meet the special wants, may meet the case as far as an *efficient* support of the animal is concerned, yet it can only in exceptional cases be considered good economy.

To satisfy the craving of the stomach and to feed a nutritious food are both requirements of a healthy animal diet, which, each in their own way, may be complied with. The commercial fodder substances, as oil-cakes, meat refuse, brans and our steadily increasing supply of refuse material from breweries, starch works, glucose factories, etc., are admirably fitted to supplement our farm resources for stock-feeding; they can serve in regard to animal growth and support in a similar way as the commercial fertilizer in the growth of farm crops, by supplementing our home resources. To feed an excess of fodder materials, as roots and potatoes, which contain a large proportion of non-nitrogenous substances, as starch, sugar, digestible cellular substance, etc., means direct waste; for they are ejected by the animal, and do not materially benefit the manure heap. In case of an excessive consumption of nitrogenous constituents, a part of the expense is saved in an increased value of the manure, yet scarcely enough to recommend that practice beyond mere exceptional cases. The aim, therefore, of an economical stock-

feeding must be to compound our various fodder materials in such a manner that the largest quantity of each of the three groups of fodder substances which the animal is capable to assimilate should be contained in its daily diet to meet the purpose for which it is kept. To compound the fodder ration of our farm stock with reference to the special wants of each class of them is an essential requirement for a satisfactory performance of their functions; to supply these wants in an economical way controls the financial success of the industry.

The problem is an intricate one; years of careful experimenting were required to accumulate observations sufficient in number and in quality to impart to the conclusion arrived at the claim of being worthy of a serious consideration. The first attempt to lay down rules for compounding the fodder rations of all kinds of farm stock on rational scientific principles was made by Dr. Grouven, Director of the Agricultural Experiment Station, at Salzmünden, Germany, 1858–1864. He began his work with a critical compilation of feeding experiments made by competent parties, some ninety in number, his own extensive experiments included. He ascertained, in each case, the amount of each fodder substance consumed per day during each experiment; and calculated subsequently from their analyses the character and the amount of the daily fodder rations.

By this operation he learned the exact amount of nitrogenous, non-nitrogenous and mineral substances digested per day, under definite circumstances, by each class of farm animals. The amount of fat which had been fed in the fodder substances was separately recorded on account of its exceptionally high feeding value as heat-producing material. The results of his calculations were repeatedly tried by actual feeding experiments, to test the correctness of his conclusions. The main object of Grouven's work consisted in bringing the results of more than twenty years' careful investigations within the reach of the practical farmer. In presenting his fodder standards to them, he recognized the natural imperfections of a first effort. More than twenty years' additional experience in leading European agricultural experiment stations has modified some details in

Grouven's statement; yet the great value of his method, to compound rational and thus more economical fodder rations for farm animals, has received an unqualified endorsement.

As the revised feeding standards deserve the most serious attention of all those who take an active part in studying the best and most economical mode of stock-feeding with reference to our leading fodder resources, I insert in this connection the latest edition for 1883 (Mentzel and Lengerke, Berlin). As a starting point for future feeding experiments, they furnish most valuable instructions.

(A.) *By Day, and 1,000 lbs. Live Weight.*

KIND OF ANIMAL.	Dry organic matter.	DIGESTIBLE MATTER IN THE FODDER. Albuminoids.	Carbo-hydrates.	Fat.	Sum of Nutritive matter.	Nutritive ratio.
1. *Oxen,* —	lbs.	lbs.	lbs.	lbs.	lbs.	
At rest, . . .	17.5	0.7	8.0	0.15	8.85	11 :2.0
2. *Sheep,* —						
Coarse breed, . .	20.0	1.2	10.3	0.20	11.70	1 :9.0
Fine breed, . .	22.5	1.5	11.4	0.25	13.15	1 :8.0
3. *Oxen,* —						
At medium work, .	24.0	1.6	11.3	0.30	13.20	1 :7 5
At hard work, . .	26.0	2.4	13.2	0.50	16.10	1 :6.0
4. *Horse,* —						
At easy work, . .	21.0	1.5	9.5	0.40	11.40	1 :7.0
At medium work, .	22.5	1.8	11.2	0.60	13.60	1 :7.0
At hard work, . .	25.5	2.8	13.4	0 80	17.00	1 :5.5
5. *Milch Cow,* —	24.0	2.5	12.5	0.40	15.40	1 :5.4
6. *Fattening Ox,* —						
1st period, . . .	27.0	2.5	15.0	0.50	18.00	1 :6.5
2d " . . .	26.0	3.0	14.8	0.70	18.50	1 :5.5
3d " . . .	25.0	2.7	14.8	0.60	18.10	1 :6.0
7. *Fattening Sheep,* —						
1st period, . . .	26.0	3.0	15.2	0.50	18.70	1 :5.5
2d " . . .	25.0	3.5	14.4	0.60	18.50	1 :4.5
8. *Fattening Hog,* —						
1st period, . . .	36.0	5.0	27.5		32.50	1 :5.5
2d " . . .	31.0	4.0	24.0		28.00	1 :6.0
3d " . . .	23.5	2.7	17.5		20.20	1 :6.5
9. *Growing Cattle,* —						
Months old. — Medium live weight per head.						
2–3, . 150 lbs. .	22.0	4.0	13.8	2.0	19 8	1 :4.7
3–6, . 300 lbs., .	23.4	3.2	13.5	1.0	17.7	1 :5.0
6–12, . 500 lbs., .	24.0	2.5	13.5	0.6	16.6	1 :6.0
12–18, . 700 lbs., .	24.0	2.0	13.0	0.4	15.4	1 :7.0
18–24, . 850 lbs., .	24.0	1 6	12.0	0.3	13.9	1 :8.0

(A.) *By Day and 1,000 lbs. Live Weight* — Continued.

Kind of Animal.		Dry organic matter.	Digestible Matter in the Fodder.			Sum of Nutritive matter.	Nutritive ratio.
			Albuminoids.	Carbo-hydrates.	Fat.		
10. *Growing Sheep*, —							
Months old.	Medium live weight per head.	lbs.	lbs.	lbs.	lbs.	lbs.	
5–6, .	56 lbs., .	28.0	3.2	15.6	0.8	19.6	1 :5.5
6–8, .	67 lbs., .	25.0	2.7	13.3	0.6	16.6	1 :5.5
8–11, .	75 lbs., .	23.0	2.1	11.4	0.5	14.0	1 :6.0
11–15, .	82 lbs., .	22.5	1.7	10.9	0.4	13.0	1 :7.0
15–20, .	85 lbs., .	22 0	1.4	10.4	0.3	12.1	1 :8.0
11. *Growing Fattening Swine*, —							
2–3, .	50 lbs., .	42.0	7.5	30.0		37.5	1 :4.0
3–5, .	100 lbs., .	34.0	5.0	25.0		30.0	1 :5.0
5–6, .	125 lbs., .	31.5	4.3	23.7		28.0	1 :5 5
6–8, .	170 lbs , .	27.0	3.4	20.4		23.8	1 :6.0
8–12, .	250 lbs., .	21.0	2.5	16.2		18.7	1 :6.5

(B.) *By Head and by Day.*

KIND OF ANIMAL.		Dry organic matter.	Digestible Matter in the Fodder. Albuminoids.	Carbo-hydrates.	Fat.	Sum of Nutritive matter.	Nutritive ratio.
Growing Cattle,—							
Months old.	Medium live weight per head.	lbs.	lbs.	lbs.	lbs.	lbs.	
2–3,	150 lbs.,	3.3	0.6	2.1	0.30	3.00	1 :4.7
3–5,	300 lbs.,	7.0	1.0	4.1	0.30	5.40	1 :5.0
5–6,	500 lbs.,	12.0	1.3	6.8	0.30	8.40	1 :6.0
6–8,	700 lbs.,	16.8	1.4	9.1	0.28	10.78	1 :7.0
8–12,	800 lbs.,	20.4	1.4	10.3	0.26	11.96	1 :8.0
Growing Sheep,—							
5–6,	56 lbs.,	1.6	0.18	0.87	0.045	1.095	1 :5.5
6–8,	67 lbs.,	1.7	0.17	0.85	0.040	1.060	1 :5 5
8–11,	75 lbs.,	1.7	0.16	0.85	0.037	1.047	1 :6.0
11–15,	82 lbs.,	1.8	0.14	0.89	0.032	1.062	1 :7.0
15–20,	85 lbs.,	1.9	0.12	0.88	0.025	1.047	1 :8.0
Growing Fattening Swine,—							
2–3,	50 lbs.,	2.1	0.38	1.50		1.88	1 :4.0
3–5,	100 lbs.,	3.4	0.50	2.50		3.00	15.0
5–6,	125 lbs.,	3.9	0.54	2.96		3.50	1 :5.5
6–8,	170 lbs.,	4.6	0.58	3.47		4.05	1 :6.0
8–12,	250 lbs.,	5.2	0.62	4.05		4.67	1 :6.5

The CHAIRMAN. As Professor Goessmann is not here, I will, before calling for the next paper, simply inquire if there is any desire on the part of any person here to have any discussion on this subject, or if any one has any questions to propose to any of our learned chemists, of whom we have two or three here present? We have Mr. Chadbourne, Mr. Stockbridge, and some others.

J. LYMAN SHEPARD. There is one fact to be considered in connection with this subject, and that is, that the same ration does not produce the same effect on one cow that it does on another any more than the same food produces the same effect on two persons. One person will digest one kind of food and another person another, so I find myself in a fog on this matter, unless I take my experience as a guide. I have eight cows that I am feeding, and if I feed the same amount and the same kind of food to each cow, I find one cow falls away and another one increases her milk. I find, also, in feeding different kinds of fodder — corn-meal, clover hay, meadow hay, wheat-straw — that some cows respond at once to one kind of food and other cows to another, so that I do not think there can be any rule laid down which will always answer. I think a person who would feed judiciously and intelligently has got to study the nature of the animal which he is feeding, and adapt the food to the particular cow or other animal that he is feeding; for instance, I feed some days wheat-straw, which will increase the amount of milk from some of my cows one, two, or three quarts a day; another one will increase her flow of milk if fed a ration of oat-straw, with the oats in connection with it, as they grow in the field; others increase their quantity of milk more largely on clover hay. I should like to get all the information I can on this subject. If there is anybody present who has been experimenting in the same direction, I should like to hear the result of his experiments.

Mr. A. W. BROWN. I am very much interested in this question. I want to get some practical ideas on questions like these: How much butter and how much beef will a hundred weight of meal make, a hundred weight of oats, or any other feed? What we want to get at is the value of a certain quantity of food for the production of milk, butter, and

beef. We practical farmers are not particularly benefited by knowing the amount of nitrogenous materials in certain articles; we want to know their value for the production of the articles I have mentioned. If any professor can give us that information, we want it.

Mr. HILLMAN of Marlborough. There is a point which occasions me a great deal of difficulty; it is this: It takes a large amount of study on my part to comprehend these long tables sufficiently to draw plain, practical working facts out of them, that I can apply in the feeding of my stock. Now, if this Board would suggest to the State chemist to simplify and popularize, so far as it is possible, these statements, bring them down to the capacity of a common farmer who was born too soon to have the benefit of an education at the Agricultural College, so that we can get something that we can use, it would do us a great service. A few weeks ago I went to work one day, when I was shut in on account of ill-health, on Professor Sanborn's essay which he gave at the country meeting of the Board last year, and I worked harder on that all day than I ever worked in the hayfield. I saw on looking into it that there was a rich mine of wealth, if a man only understood clearly the principle, so that he could work out all the information which Professor Sanborn embodied in that essay. I studied it as carefully as I could, and I finally decided upon what seemed to me to be a sensible ration to make up for feeding to my stock. I had been feeding all my cows the same feed; I was not satisfied with the results; I did not know as I could get any better results; but a few days after that I commenced with a ration which it seemed to me was sensible, so far as furnishing to the cows the nutritive qualities they needed, and at a reasonable expense, as far as the cost of the ration was concerned. What was the result? The first day of feeding the cows fell off in their milk; the second day they gave about the same quantity that they had been giving previously to the change; the third day there was an increase; the fourth day the aggregate increase in milk was twenty-five per cent.; the fifth day one or two cows had doubled their yield of milk. One or two cows had illustrated the fact which my friend a moment ago stated, that the same food does not affect all animals alike.

The ration did not seem to affect them as favorably as some of the others; they were giving no more milk than before. I am following along in that direction; groping in the dark a good deal. I do not know as clearly as I wish I did what I am doing, or why I am getting the results which I see, but still I am going to follow along and watch.

But the point that I rose to make was this: If there could be some way contrived so that this vast mass of information could be simplified, so that the farmer, as he takes it up and looks at it, can say, "I see just what that means; I can take that and go to work with it just the same as with my mowing-machine, or horse-rake, or plough," it seems to me that we should get a vast amount of benefit; a benefit that would result in thousands, if not in millions, of dollars to New England every single year.

Mr. West. What are you feeding?

Mr. Hillman. I am feeding meadow hay of tolerably fair quality, corn stubble, the whole stalk cut up at the roots, English hay, corn meal, ground cob and all, shorts and cotton seed.

Mr. West. In what proportions?

Mr. Hillman. I was satisfied from Prof. Sanborn's statements that the best hay that we get, while it furnishes a good share of carbo-hydrates, lacks protein; and the same statement applies to corn meal; but cotton seed furnishes protein very largely in excess of the carbo-hydrates; and so I tried to get an accurate balance of the various qualities that a cow requires by adding what would furnish more of the protein and less of the carbo-hydrates. Prof. Sanborn stated about the quantity of carbo-hydrates and about the quantity of protein that an animal requires, and I was able to determine from what he said about what kind of food would furnish those materials, and I tried to make up a combination which would meet the wants of the animal. That is about what I have tried to do in my feeble way.

Mr. West. The combination is what I would like to know.

Mr. Hillman. To start with, I give my cows in the morning meadow hay — not a very heavy foddering. As soon as the hay is cleaned up, I feed the corn stover. Then

I give them a mixture composed of equal parts of cotton seed, corn meal, ground cob and all, and shorts.

Mr. West. How much to each cow?

Mr. Hillman. I commenced with my older cows and heavier milkers, giving a quart of each ingredient of the ration morning and night, with a foddering of hay, etc.—not a heavy foddering, as I have said; and I found, after watching those animals awhile, that I could see that it improved their appearance; and that was followed by an increase of milk. I don't know whether I am working in the right direction or not, but I am going to follow along until I see some reason for making a change. I am going to feel my way along; but if we could have something that would give us a more definite statement, without so much digging for it, it seems to me that we should derive greater benefit.

President Chadbourne. The gentleman said that he worked one whole day on those tables, and, as I understood him, that he never worked harder in the hayfield in his life. I think it is apparent to this whole audience that he never earned more by working all day in the hayfield than he did by working over these tables.

Mr. Hillman. Not half as much.

President Chadbourne. He says he was not born early enough to be trained in an agricultural college. If a man learns as much in one day, with hard study, as he did, what would happen to him if he worked four years at the agricultural college and studied just as hard?

Now, I have risen for the purpose of driving a nail home here if I can, and that is to say that it requires hard study, not only one day, but two days, and one year, and two years, and this thing cannot be simplified so much that it will not require hard study on the part of every farmer who wants to consult these tables and understand what they really mean. A great deal can be done in simplifying. I believe in that. I believe in making studies plain, simple and easy for the student. I do not believe in the old doctrine that students must have everything made hard in order to get a good deal of exercise out of it. They say you want to make things hard in order that the boys may get

exercise, and they give a boy a stone hatchet and send him out to cut down a white-oak tree, in order that he may get exercise enough. I would give him a good steel axe and let him cut down more trees. I would have all the tables and statements made just as clear and plain as they can be. I was glad to have the gentleman touch upon that point, and I want the secretary to bear that in mind. I want to say to him, that notwithstanding those little compliments that I paid him yesterday, I think he might have these statements and tables made much more simple, and save much time on the part of those who examine these reports. Now let me say, that after every single statement is made as clear as possible, after every single table is worked down to the smallest possible result to give the real result; then, after all that is done, let me say that you never can reach what you want to reach without hard study in the farmer's home, night and day. You have got to work as hard as you do in the hayfield. I know what it is to work in the hayfield; I know what it is to build a plough and plough with it; I know what it is to mow my swathe in the field; I have to teach men who come to me to learn how to mow — that is one of the last points, almost; but I did not work so hard in the hayfield as I do in my study at night in order to understand these tables. I have to work to understand them. And now let me say, that after everything is done that can be done, after all the chemists in the world, Professor Goessmann and the whole army of them, have done all they can to tell you exactly how much nitrogen, oxygen, carbon and phosphates are found in any given food for cattle, they will never do enough to bring farming down to a mere machine operation. The farmer has got to understand that his farm needs brains, a mind quick to observe, and studying every day, as the physician does who comes to your bedside. Medicine is called a science, but how much difference between one doctor and another! Why, I have made lots of them. I saw one here yesterday that I helped to make, and I do not know but there are others here this morning. I say medicine is a science, but how much difference between one doctor and another! Because one doctor can see a difference in patients, and he does not give the same medicine

to different patients, even when they have the same disease. And so you must learn to study your stock, you must learn to study your crops, and you must learn also that meadow hay is not the same from year to year. Years differ. Some years there is more rain and more clouds; other years, there is more sunshine. Old farmers understand that, to some extent. They say, "This year the hay will spend well." Well, it does spend better some years than others; there is no question about it. So you want to know when to cut your hay and how to cure your hay. These substances will change in their relations to the stomach of the animal according to the manner in which they are cured. And, therefore, after you have had your tables all at your hand, you have got to study these things night and day, or else you will not get the best results. The time will never come,—I am glad of it,—the time will never come when the farmer can sit down and feel that he can work out these things mechanically and become a mere machine. No, he has got to become a living, thinking man, and the time never will come when a cow's stomach will become a mere laboratory. It is a living thing as well as a laboratory. A distinguished man in this State said to me the other day, in talking of the experiment station, "After all, you have got to come down to chemistry to learn the real value of food." I said to him, "No, sir; you have got to go to the stomach of the cow. There is the place where you have got to go. There is the last analysis."

I have taught chemistry a great many years; I have worked in the chemical laboratory a great many years; I do not profess to know as much as some of our chemists, but I know enough to know that no chemical analysis will ever tell us the exact value of food, under all conditions. It will help us a great deal, but we want the reports of farmers, and, above all, we want intelligent, educated farmers, men who will sit down and work every day over tables harder than they do in their hayfields. Give us such farmers, and we shall have successful farming, and not until then.

The CHAIRMAN. You have an idea, now, what the agricultural experiment station is going to do.

President CHADBOURNE. It is not going to relieve farmers from studying hard; it is going to make them study harder.

Mr. ———. There is one point which has not been brought out. The gentleman who spoke of the increased quantity of milk furnished by his cows by a change in their rations said that while some of his animals doubled in their production, there was no advance in some others. Now there is a radical reason, I think, for that difference. I would like to hear this matter debated in its broadest aspect, that we may better understand it.

Mr. HILLMAN. I would inquire of President Chadbourne what steps a farmer should take in order to derive benefit from the experiment station. I think information as to the method by which we are to reach such benefit might be very valuable at this time, as farmers from different parts of the State are collected here in such numbers. And I would say in reference to the point which was raised just now, nine-tenths of the cows did respond to the changed ration. It is possible that the other tenth might have been out of condition, or something of that sort, which I did not have time to observe. Very likely, if I had observed more carefully, I would have found a good and sufficient reason for the fact that they did not improve.

President CHADBOURNE. On every farm that is well conducted, and especially where the farmer is intelligent, and at the same time has not had the advantage of a technical or scientific education, many questions will arise that he would be glad to have answered if he knew just where to send the questions. That is the first thing which an experiment station is appointed to do. It is to receive questions from farmers all over the State, and if the knowledge is now at hand, an answer will be sent back to them. If the knowledge is not at hand, if that thing is not known, then there is a point made, that there are experiments to be tried. Here and there a question will arise on our farms that cannot be answered by any experiments thus far tried. Now, we are to go to work and try, in the best manner we can, the experiments that will enable us to answer those questions. That is the second step. Then oftentimes farmers have

manures which they want tested. They want different kinds of fodder tested. They may be sent to the experiment station, and we will do all we can to test their value, and make suggestions in regard to their value and the best method of using them. That is the third point. Then, over and above that, there is a whole line of experiments that have been begun, and others that have been simply suggested, that will be taken up by the experiment station and carried on year after year by men thoroughly trained to that work; men who, having turned aside from other pursuits, make that their business; men who are responsible to the board of control; men who are responsible to the people of the State; and as soon as they reach any results, they are to give them to the papers, and they are to send them out in the reports, so that the farmers can have them in the most available form; and if they do not come to you in the form of tables or statements that you can perfectly understand, then it is your business, and I hope you will do it, to send them back to the experiment station, and let them try another experiment in that direction, and see if they cannot make themselves understood.

Now I am ready to answer any other question, or will try to.

Mr. SEARLE of Park Hill. I have a question in mind which I would like very much to hear answered, which may be a little one side of the point in view at the present time, but I think it is in close connection with it. The time has come when we in New England are driven to the wall in regard to the matter of fertilizing our soil. It has become depleted. Where have our young men been driven to? They have been driven from New England to more propitious fields, unavoidably. If we would keep the young men of New England from emigrating to the West, the first thing is to show them how we can fertilize our soil. The question is, In what fertilizer can we find this boon? In what fertilizer can we receive dollar for dollar? I have discarded all fertilizers, from the fact that they cost more than they are worth, except wood ashes. I can buy wood ashes and make a margin of profit. But we cannot get the quantity of wood ashes

that we want. I would like to know the difference, as plant food, between hard-wood ashes and soft-wood ashes.

The CHAIRMAN. The question is the feeding of stock and not the value of fertilizers.

Mr. SEARLE. I understand that, but I wonder how we are going to feed stock, unless we can grow something to feed them on.

The CHAIRMAN. There is sufficient time before the adjournment to hear the paper on tobacco, as first proposed. If you will give your attention, Mr. Smith of Sunderland, one of the largest farmers in the country, and a grower of tobacco, will read an essay on the cultivation of that plant. It was expected that we should have a large exhibition of tobacco, but we are disappointed in that regard. The reason is, that the weather has been so cool and dry that it has been almost impossible to take tobacco down without breaking it all to pieces.

TOBACCO AND ITS CULTURE IN THE CONNECTICUT RIVER VALLEY.

BY J. M. SMITH OF SUNDERLAND.

On five previous occasions since the organization of your Board have you honored our Connecticut Valley by coming to it to hold your annual country meeting.

We have listened with pleasure and profit to your discussions of almost every subject relating to our agricultural industry. We have by you been instructed in the husbandry of cattle, horses, sheep and swine. We have been taught of the culture of the cereals, and of all manner of fruit and root crops. You have for our enlightenment discussed manures, commercial fertilizers, their application and value, the products of the dairy, their manufacture and manner of marketing.

We remember, too, with profound gratitude, how the renowned Agassiz, with his remarkable simplicity of manner, always interested himself in the apparent little things of our every-day life, and how he always was ready to impart from his abundant fountain of knowledge to every person whom he met, however humble a personage he might be.

We remember other individuals, also, who have joined in these discussions upon these or kindred matters. But to-day we not only see new faces, but we meet to discuss a subject which, with the exception of a brief report made by a committee to your Board some twenty years since, has not by you been brought before us. We come here this morning to talk about one of the principal crops, not only of the Connecticut Valley, but of the world; a crop, one branch of the manufacture and commerce of which is increasing very rapidly, is assuming vast proportions, and will soon, if it is not already, become a great monopoly.

Of its use by man—

> "It is used in every clime,
> By all men, high and low;
> It is praised in prose and rhyme,
> So let the kind herb grow.
>
> "'Tis a friend to the distressed,
> 'Tis a comforter in need;
> It is social, soothing, blest;
> It has fragrance, force and zest;
> Then hail to the kingly weed!"

But little is known of the cultivation of tobacco till almost the sixteenth century, although it had been cultivated by the Indians found here, for an unknown period prior to that date.

Brock's history of tobacco in Virginia contains a long account of its being discovered by the companions of Columbus, who, in November, 1492, while on their first voyage to America, saw the native Cubans smoking.

Two years afterwards, the same parties saw the natives using it as snuff. When the Spaniards landed at Paraguay in 1503, the natives came forth to oppose them, beating drums, throwing water, chewing herbs and spitting the juice toward them. As early as 1535, the negroes who had been carried to the West India Islands had habituated themselves to the use of it, and cultivated it on the plantations of their masters. Europeans likewise smoked it. In 1559, it was introduced from San Domingo into Europe. According

to the historian, the Virginia colonists became fascinated with it. He gives the credit to John Rolfe, the husband of Pocahontas, of inaugurating, in 1612, the systematic cultivation of tobacco in the colony. According to John Rolfe's own account, he had hopes, at that time, of bringing it up in quality to compare with the best grades of the West Indies.

No sooner were its peculiar qualities made known than it was sought after with the greatest avidity, until now, after a lapse of a little more than three centuries since its introduction into Europe, its use has become universal, the whole world yielding to its fascinations in one or more forms of its use: smokers, chewers, or snuffers. Among artificial stimulants in popular estimation tobacco reigns supreme.

As many as forty varieties have been noted by botanists, to one of which Virginia is indebted for her material prosperity, which has held the most important relation as a staple product quite from its first settlement as a colony, and has been one of the chief sources of wealth, and has undoubtedly formed the basis of the unrivalled commercial prosperity of the United States.

Soon after the settlement of Virginia by the English, its value was made known to them, and we learn that but a short time after the settlement of Jamestown, it became quite an article of culture and commerce. The demand in England continued from year to year, and as the price increased, the Virginia farmers were stimulated to hazard their time and labor upon this crop, to the neglect of the crops of grains. In 1621, the governor and council in Virginia were induced to "restrayne the planters from the 'Immoderate Plantings of Tobacco.'" They were allowed to raise only one hundred pounds per head, and that none should be raised but that of good quality "there were to be left on butt nyne leaves on eache of the plantes."

In 1639, tobacco was ordered to be inspected, and all unmerchantable, as well as all half good, was ordered to be burned, to reduce the whole unit to 1,500,000 lbs. The crops of 1640 and 1641 were restricted 1,300,000 lbs.

In 1640, the price of tobacco was fixed at 12*d*. per pound;

in 1641, 20*d.* per pound. In 1646, the culture of tobacco was introduced into the Dutch Colony of New York.

In March, 1657–58, by enactment, the planting of tobacco after July 10 was forbidden under a heavy penalty. At the same time the packing of five pounds of ground leaves among top tobacco was cause for its being burned.

The manner of transporting the crop to market was somewhat simple, and in accordance with the times. Stout spikes or pins about two feet long were driven into the centre of the head of the hogshead of tobacco, to which shafts were attached, between which the horse or mule was driven a journey of perhaps a week's duration, the hogshead of tobacco being actually rolled through mud, dirt and stream to its destination, the owner carrying food for himself and animal and a few tools for repairs in the case of accident, and camping out at night by the side of his season's crop. The storehouses or rolling-houses, as they were then called, after the manner of transportation, were appointed (one in each county) by the government.

Other of the Southern States besides Virginia have cultivated tobacco for a long time, and, contrary to the prevailing opinion, Kentucky raises more than Virginia — more than twice as much in fact; she raises thirty-six per cent. of the entire tobacco crop of the country, which by the last census amounted to a little more than 473,000,000 pounds, or 9½ pounds to every inhabitant, young and old. The yield per acre varies from 471 pounds in North Carolina, to 1,340 in Pennsylvania, 1,599 in Massachusetts, and 1,620 in Connecticut.

It is not our purpose in this paper to extend the account of the early cultivation of tobacco by the Virginians, and give a recital of their buying their wives with tobacco, or of their fraudulent proceedings to cheat their government of taxes, etc.

But it is our purpose to treat of the subject under consideration only as to its culture and relation to the interests of the Connecticut Valley farmer, to whom, as a product of the soil, it has become a source of profit, it being what may be called a special crop, a money crop, remunerating, and, when grown in rotation with other crops, beneficial to the farm,

as its cultivation prepares the land for luxuriant crops of wheat, rye, corn and grass.

Tobacco has been cultivated in the valley from about the time of its first settlement by the whites. Still farther back the Indians raised and smoked tobacco when they were sole possessors of our soil.

From the history of one of our neighboring towns, we learn a few of the following facts: "Tobacco was raised in Deerfield at an early day, as we find that the children of Mr. Daniel Belden hid among the tobacco as it was hanging in the attic to dry in the time of the Indian attack, in the fall of 1696." The amount of tobacco was so considerable as to effectually screen the children from the sharp eyes of the blood thirsty Indians. Near the close of the last and about the commencement of the present century, it was raised by many farmers in the valley; Joshua Belden, of Whately, grandfather of Dea. Reuben Belden of North Hatfield, and the late Dea. Elihu Belden of Whately, and his sons Reuben and Aaron, raised it quite extensively. The father of the writer, who was born in 1790 and lived cotemporary with the above-named Messrs. Belden, often spoke in our younger days of his experience in raising and marketing tobacco. Their method of curing was to let it hang till it was half or two-thirds dry, and then take it down and let it lie in a pile till it was considerable warm, when they would repack it two or three times to prevent its rotting, and finally strip it, twist into hands and offer it for sale.

The farmers would often take it with their teams into the country round about, and sell it to the country merchants; most probably exchange it for store goods.

I have heard my father say that they could never sell it to the same man the second year. It was so imperfectly cured, that it would rot on his hands and prove a loss.

The more extensive cultivation of tobacco did not commence till about 1835, when the plant received more attention from the farmers of the Connecticut Valley, as it was found that the soil was well adapted to the production of a very fine leaf for the manufacture of cigars, since which time "Connecticut Seed Leaf" has enjoyed an unrivalled reputation and popularity.

About 1840, some individuals in Whately commenced to raise tobacco. One Stephen Belden raised two crops which he packed and pressed into casks which he sent to New York, where it was sold for four cents per pound. Other individuals, obtaining their seed from Suffield, Conn., raised about one acre each, raising about twelve hundred pounds per acre, and selling it, the wrappers for six cents, and fillers for two cents.

In the course of two or three years, others in the neighboring towns began to raise the weed.

For several years the marketing was done by the growers selecting several hands as samples, and at an appointed day they would carry the samples and meet a man from Suffield, Conn., at "Allen's tavern" in Hadley, who would buy the various crops.

About 1848, another gentleman from the same locality ran opposition to the previous buyer by riding around among the growers and picking up the various crops, the competition driving the prices up from six and two cents to ten and three cents per pound.

As we have already stated, the variety known as "Connecticut Seed Leaf" has, for a long time, been the most popular in our valley.

Other kinds have been introduced, but have not been so universally popular. Some kinds have been found fault with for having too large veins, or too few leaves on a plant, or because of their greater liability to be injured by storms; the leaves of the plant being larger were more liable to be broken off or torn, or otherwise injured in handling. Within a few years, a variety of seed has been imported from Cuba, and now called "Havana seed," which, after a growth of five or six years in this country, has been found to produce a leaf of such flavor and texture as to gain popular favor quite rapidly. The writer entertains the opinion that this variety possesses such qualities as to make it the most desirable to plant in this immediate section of the valley.

So great a number of pounds to the acre is not usually produced as of the "Connecticut Seed Leaf" variety, but as it commands a greater price per pound, the deficiency is made up. As the plants are set some considerably nearer

together than the larger kinds, a larger number of plants to the acre is required, which makes some labor in setting, but we think the after culture is less expensive than the larger kinds.

We would recommend the use of seed of about seven years' growth from importations, and when the planter has obtained seed of the most desirable qualities, he should save enough for his use for several years, thereby saving the deterioration in the quality of his tobacco. Seed eight or ten years old is just as good for use, excepting that it may take a little longer time to germinate as it grows older.

Considerable might be said as to the character of the soil requisite for growing a leaf of the most desirable qualities, for the soil, the manure, and the manner of curing, have much to do with the texture and color. Fashion governs the color desired for cigar wrappers. But a few years since, fashion demanded a light cinnamon color, but at present she requires a very dark leaf, an almost black wrapper. It is also of great importance that the veins of the leaf be not prominent, either in size or color; tobacco having large, light-colored veins is considered as unfit for making nice cigars. These qualities may seem unimportant to the unobserving grower, but it makes a difference of several cents a pound in the value of the crop. The soil, the season, and the fertilizers used, have more or less influence in producing the qualities, and just what, and how, should be the growers' study to know. Another requisite of essential importance is, that a cigar burn well; the ashes must be of a clear white color, and sufficiently adhesive to hold their form on the end of the cigar when burning, and not drop off upon the smoker's clothes, much to his chagrin. A dark soil, one inclined to heaviness, or clayey, favors a dark leaf; the manner of curing, also, if after the danger of pole sweat is past the barn be shut up so that the crop cure in the dark, also favors a dark leaf. The so called commercial fertilizers, especially Peruvian guano, will affect the color in a like manner, but at the expense of the burning qualities. I believe it is conceded that tobacco grown with the use of barnyard manure, principally, will generally burn well. To this may, perhaps, be excepted land which has become exhausted of lime.

It is of the first importance, as affecting the profit of the tobacco grower, that he have a good bed of plants near at hand, and in season that he may be able to take advantage of favorable weather for setting. It is poor economy to neglect sowing and caring for the seed-beds, and thus be obliged to go some distance, perhaps to a neighboring town, for plants at the busy time of setting, and then, perhaps, wait till others are through before you can get them. Select a warm, sheltered spot for the seed-bed, and make it rich with some approved fertilizer; horse manure may be ploughed in, in the autumn previous to its being wanted. It may be further dressed with some of the phosphates in the early spring. Some persons use commercial fertilizers only because of their being free from weed seed. Some quick-acting fertilizer will be necessary if the bed has not been made rich for previous use.

Peruvian guano has been a great favorite for tobacco beds. The tobacco fertilizers have also given satisfaction for starting plants. Bowker's Corn Fertilizer is also recommended by some of our most successful tobacco growers, and in many cases is the only fertilizer used. Early sowing of the seed is essential. While some men will hesitate and delay because they think the ground is too cold, my own rule is to sow any seed, the growing plants of which are not likely to be injured by the frost, as soon as the ground can be worked without packing. There is frequently such a time for seed sowing quite early, after which it may be a long time before the ground will be in as good condition again.

The saying that it is of no use to put seed in the ground while it is yet so cold, is very good in theory, but in practice will not always hold true. Every planter should plan to raise two or three times as many plants as he will be likely to need; the greater abundance of plants you have the better can be your selections for the transplanting, and the greater number can be transplanted in a more favorable time. Those you may have left, after you are through setting, will be wanted by some afternoon man less fortunate.

Shall glass be used?

We answer, yes. Cold frames for the protection and hastening forward of the young plants. But it is not neces-

sary that all of your plants should be grown under glass, but enough to insure your early plants to take advantage of favorable weather in transplanting. It is also convenient to have a portion of the crop earlier than the remainder, that it may not all require harvesting at the same time.

But the writer, with twenty-five years' experience without glass, has never failed to get good plants in season; yet the spring of 1882 was very backward, and a few plants grown under glass that spring would have saved enough labor to pay for the glass. Without glass the beds may be so protected with brush as to break the effect of cold winds.

Many people hesitate about applying water to beds, for the reason, as they say, if they commence to water it will have to be continued; which is very true. It is also true that artificial watering cannot be so beneficial as a good shower. But he who undertakes to grow tobacco, must spare no labor or care, from beginning to end; and if he would have good early plants he must commence to water even before the plants are up, if the ground shows signs of drying up.

Artificial watering has one advantage in itse.f. It furnishes a most excellent way to apply liquid manure to hasten forward the growing plants. For this purpose nothing is better than the drainage from the barnyard.

Water, thoroughly charged with Peruvian guano or hen manure, is often used with success. Judgment should be used, so that the liquid shall not be made too strong, as it may burn and destroy the plants.

Transplanting tobacco may be successfully done from the twentieth of May till the first of July, and is often done later than the latter date.

The danger of very early-set tobacco is, that is may be caught by frosts before it is harvested, or it may be liable to be frozen in the building where hung before it is cured.

Tobacco set early may become ripe too early, and the harvesting become necessary to be done while the weather is yet too warm and sultry, and be in danger of pole sweat in the building. And further, if the tobacco ripens off while the nights are quite cool, the leaf will have more body, character and weight. There is a right time in every season for

setting tobacco, and the nearer one can hit that time the more fortunate is he. Between the 5th and 15th of June is generally the best time. Late-set tobacco has one advantage over early-set, which in some seasons is of great value. The plants do not have so long time to contend with the cut-worm, which usually disappears the first part of July.

To have the land in the best possible condition to receive the growing plant is of the utmost importance. It is of no use to think of setting the minute rootlets of the tobacco plant with the expectation that it will thrive in soil which is made up mostly of hard nubs of dirt, the size of one's fist, or where one-half of the land which you have prepared is composed of corn-stalks and turf.

A very successful tobacco grower, now past eighty years old, who lives less than a thousand miles from Mount Sugar-loaf, says that people often ask how he and his son succeed in getting so large an amount of tobacco to the acre. "It is no secret," says he; "we fertilize well and then fit our land well; we plough and harrow, and plough and harrow again, till the manure is thoroughly mixed with the soil, and the soil is in a very fine tilth." That was his method of getting from twenty-four to twenty-six hundred pounds of "Havana" tobacco to the acre. The rest of us might do the same if we would follow his plan.

Without egotism, the writer would like to give his way of raising a good crop of tobacco.

In the first place, I would prefer land upon which tobacco has been grown the two years previous; and here let me say, that I would not grow tobacco more than three or four years in succession on the same piece, for the reason that I wish to grow this crop in rotation over the whole farm and prepare the land for bountiful crops of grain or grass to follow, which matter I shall allude to again hereafter.

Having chosen my land, I would cart and spread, and plough in as early in the spring as the land would be in a condition to go onto without injury to the land, from twenty to twenty-five cart-loads of stable manure — the excrements of domestic animals fed with English hay, wheat bran, corn and cotton-seed meal prepared. Once or twice in the interval previous to the second ploughing, I would thoroughly harrow

the piece and go over it with some implement to crush the nubs, if there were any. After the second ploughing, which would be performed about two weeks before plant-setting commenced, having thoroughly harrowed and re-harrowed the land, I would, with a double mould-board plough, furrow it in rows three feet apart, and then strew from twelve to fifteen cart-loads of compost manure in the furrows, which would then be covered with a "tobacco ridger." The "ridger" further pulverizes the land to receive the plant. If in the course of a week or ten days the plants are not ready for setting, go over the piece with a horse cultivator, first between the rows, then on the rows, running the cultivator teeth down into the manure, mixing it with the soil; then immediately follow with the ridger again, taking pains to make the rows where they were before, over the manure.

This process destroys the small weeds and is fully equal to one hoeing, and more easily and cheaply done. The land is made fresh to receive the plant, the roots of which should be put down straight into the hole made for them and not crammed into the ground doubled up; neither should the hole made for the plant be made with a stick and the bottom of the hole left without filling with soil; the soil should be pressed firmly and completely around the roots of the plant.

The time for the tobacco plant to arrive at maturity is so short, that if the manure is put into the hill (of which the strewing in the furrow is a substitute), it is placed where it is sooner found to give the plant nourishment.

The sooner the soil is stirred after the plant has given evidence of growth after being transplanted, the faster it will grow in the few weeks that follow; and the oftener the soil is stirred, till the plants become too large to pass between the rows with a horse hoe, the better the crop.

With the rows three feet apart, Prout's Horse Hoe seems pretty well adapted for tilling Havana tobacco, which can be done after the first hoeing with very little hand labor.

The great enemy to the tobacco plant is the green worm (*Macrosila Carolina*), which is an altogether different animal from the cut-worm already spoken of, which also works upon the young corn-plant as well, and is often called the corn worm,

which burrows in the ground in the daytime and comes to the surface to feed at night. The tobacco worm is hatched from an egg laid by the tobacco miller upon the under side of the tobacco leaf, and usually may be found there. They are much more troublesome some seasons than others. The only sure method to rid the plant of them is untiring vigilance in picking them off by hand and destroying them. This work continues as long as the tobacco remains in the field, and sometimes they are carried on the plant to the building, where they continue to feed upon the plant till they fall to the ground and die.

The work of topping and suckering tobacco is a work upon which there is a difference of opinion as to the time when the work should be done. My own opinion is that the bud should be broken off as soon as the plant is so far advanced as to show the character of the plant. A strong and healthy plant will bear to be topped higher than one not so healthy. The plant can be topped higher *early* in the season than *late;* and where there are some plants quite late in their growth, these should be topped much lower than those further advanced, which have been topped earlier. It is clear that all superfluous growth allowed is at the expense of the strength of the plant, which is a sufficient reason for early topping; and further, after the plant has been topped, it is less likely to be injured by wind and storm; and further, if the topping is delayed till fully blossomed out, the quality of the leaf is affected unfavorably. The number of leaves to be allowed to remain on the plant varies with the variety of seed, with the time in the season when it is topped, whether early or late, and with the fertility of the soil; some varieties will not mature more than twelve or fourteen leaves, while others will mature from sixteen to twenty.

The risk to the crop from hail-storms and wind stimulates the tobacco grower to early harvesting, so as to have his crop safe under cover. There is certainly a feeling of relief when the crop is safely housed, but there should not be so much haste as to harvest before the crop is ripe, as the market value is often injured by its being cut before it is matured. To be able to judge accurately when the crop is in its best condition to harvest, if ever acquired, can only be by experi-

ence. Yet there are some signs of maturity which will help one to judge of its ripeness. In the first place, when the plant is becoming ripe, or nearly so, the leaf presents a mottled or calico appearance. Second, the suckers, which commence to grow at the axil of the leaf at the top of the plant first, and work downward, will become two or three inches in length at the roots when the plant is ripe. After topping, the plant requires to stand not less than twenty days to ripen, and Havana seed requires a period of four weeks after topping. A farmer has recently told me that he considers it advantageous to let Havana tobacco stand much longer than that.

A building made especially for the purpose should be provided for curing tobacco, with hanging doors on each side for airing, and with sufficient means for ventilation at the top and bottom of the building. Unless one can provide such a building, with good sawn poles for hanging the crop, the raising of the crop had better not be attempted. A large share of the accidents which befall persons in hanging or in taking down the crop, results from poorly arranged buildings. A building not more than thirty feet wide is preferable to those that are wider (twenty-six feet is better), as tobacco will cure better, and dampen better also, in a narrow building.

The tiers should be five feet apart, and only three tiers in height; tobacco hung near the ground is of better quality than that hung higher.

There are several ways of fastening the plant to the pole for curing. The more common ones, however, and the only ones with which the writer has had personal experience, are two: one by the means of twine wound around each plant, and the other by splitting the stalk of the plant to run through it a slat or lath, five or six plants being put upon each slat, and the slat is then hung on poles.

Of these two methods, the writer is strongly of the opinion that the former is preferable, and each successive year's experience strengthens this opinion. My reasons for this opinion are: The act of splitting the stalk hastens the drying of the leaf to such an extent that the quality of the leaf is affected unfavorably; for the same reason, kiln-dried tobacco will not produce a leaf of so good texture, flavor or color;

still further, I am inclined to think that the majority of the growers practise taking down the crop too early in the season, to which I shall again allude.

As in housing the crop, there is usually too great haste by many farmers to get it down from the poles. Take the crop of 1881 for instance. It was a misfortune to the grower that the speculators should commence operations while the crop was still on the poles, and in an unmerchantable condition; the result proved it. While the negotiations were being made, the grower was assured by the buyer that he would take it as soon as it was ready; consequently there was an eagerness on the part of the seller to get it down off his hands, and the money for it. The first damp spell (in October), down it came, and in some instances too damp. Warm weather followed, the tobacco became hot in the pile, requiring handling over to be cooled; it never looked so well afterward; would lose somewhat in weight by heating, and in some cases the buyer refused to take it, as it was not in good order.

Growers frequently complain of the speculators who try to cheapen and find fault with their goods, when the grower himself is his own worst enemy. He does not take sufficient care in handling his crop while harvesting; his avariciousness has led him to dampen or apply water to make it weigh more, and the crop becomes injured beyond recovery. Such methods not only injure those who practise them, but all tobacco growers. There is nearly as much injury in getting tobacco too damp when taken down, as there is in not getting it damp enough. If it is taken down early in the season, it will not be safe to have it quite as damp as if later. That which hangs near to open doors and gets wet, should not be put in the same pile with that which is in good order, as the wet tobacco will injure that with which it comes in contact.

As has been said, the majority of growers consider that the best time to take down tobacco is during the month of November, provided the weather is suitable. Yet we find that there is a difference of opinion in regard to the best time for this work. Some persons whose opinions upon this matter are worthy of consideration contend that they get good compensation for delaying till March, and say that they

would not have their tobacco taken down and stripped before this time, if the work were done for nothing. Their theory is, that by the repeated dampening and drying of the leaf while it remains on the stalk, and by the process of freezing and thawing, the juice of the stalk runs down into the veins of the leaf, by which the leaf becomes more even in color, of better quality and heavier.

There is always more or less risk in taking down tobacco in cold weather, without the stalk is cured as well as the leaf, as otherwise the frost as it comes out of the stalk will stain the leaf with which it comes in contact while in the pile before it is stripped. This stain, or water color, when it does affect the leaf, is a permanent injury.

There is also the same liability to discoloration of the leaf if the tobacco is taken down quite early in the season, while the stalk is quite green and full of sap; and still further, if the tobacco is taken down quite early in the season, when the weather is warm, and the stripped tobacco is placed in a pile, or rank as it is often called, it will most surely heat in the pile. When it once becomes warm or hot, either before it is stripped or after, it is a very difficult matter to bring it to a proper temperature afterwards, without exposing it too much to the drying influences of the atmosphere.

There is but little danger of its sweating or "warming up," as it is called, in cool weather, if it is cool itself when packed down, without it is too damp to be merchantable. When it has warmed up to any considerable degree, it has become injured in weight and in appearance, especially the latter, if it has been necessary to handle it over for repacking.

In this locality, the tobacco leaves, after being stripped from the stalks, are usually tied in bundles (single bundles are best) of about six pounds each; these are packed in piles or ranks, as referred to before, two bundles wide, with the butts outward, and the tips of the leaves overlapping each other enough to have the pile level when it is pressed down, and are left in this condition a few weeks for the butts to become dry, or till the crop may be sold in this State.

Without the grower has good facilities for sorting, and

understands the art of sorting and packing in cases, it is better for him to dispose of it in the bundle, if he can at a fair price, as then the buyer can assort it to suit himself.

What is called "table sorting" is the process of looking it over leaf by leaf, and is done by the growers to a considerable extent in the leisure months of winter. The bundles are then taken to a warm room, usually one fitted for the purpose, with a good, strong light; a room of northerly exposure is better, because of the light being more even, and because of the absence of the direct rays of the sun. In sorting, the leaves are placed in three or four classes, as their quality may require. These classes are called "perfects" or "first wrappers," "second wrappers," "seconds," and "fillers." The "second wrappers" may include leaves of desirable quality, but imperfect, having been torn in handling, or from some other cause. These different classes are each tied into hands. There is a tendency to make these hands too large, as it requires less time, but for the best wrappers or "selections," fourteen leaves are enough for a hand. These hands should be uniform in size, and the butts of the leaves should be placed together evenly, the band put around within a half-inch of the butt end. The band should be wound three or four times, and the end tucked in between the leaves neatly; the end of the hand should be then squeezed together with the left hand, the leaves drawn together with the right, and laid straight in the pile.

For the tying bands, the smallest leaves should be selected from the "seconds," during the operation of sorting. These bands should not be ragged, nor too large, as large bands will give the hand a bungling look. For casing the crop, cases should be procured, of a length adapted to the crop, to the size or length of the leaves or hands. The case should be what is called "open end," or cracks between each board of the end should be left in nailing together, one-eighth of an inch in width. This is for the purpose of ventilating the butts, while the tobacco is going through the sweating process.

When the hands of tobacco are laid in the case, there should be some short boards, one-half inch in thickness (as

long as the box is deep), placed at the end of the case inside, and when the case is full, these can be drawn out, leaving a half-inch space at each end of the case, also for ventilation.

When the hands are placed in the case, they should be not more than two at a time (one is better), and laid perfectly compact and straight to the tips of the leaves, which should overlap each other in courses alternating so that when pressed it will be so evenly put in and pressed that all parts of the leaf shall sweat alike. About three hundred and seventy-five pounds are enough for each case. Very long tobacco will demand a longer case, and admit more pounds of tobacco in each case. A case forty-two inches long is the usual length. I have thus far been quite minute in my instructions for sorting and casing, because it is important. Many a good crop of tobacco is spoilt in the handling. It is of no use to expend so much in labor and fertilizer for the growth of the crop, and then spoil it by careless handling.

The cultivation of tobacco has gradually been entered into by other of the Northern States during the last twenty years. New York State has been engaged in it for a longer period, but Ohio, Wisconsin, Missouri, and some others have of late been competitors with Connecticut and Massachusetts in raising cigar leaf, while of Pennsylvania it may be said truly, that, for a time, it seemed that the desirable quality of her goods, and the care exercised by the growers in the cultivation of the leaf, would break down the popularity of "Connecticut Seed Leaf."

The character of the soil in some of the counties of Pennsylvania seems to be quite favorable to the production of a leaf which has gained popular favor with the cigar trade, and to become already our rival. Some few years since, those who had crops to dispose of in our valley did not fail to hear of the excellences of Wisconsin tobacco; since which time, Wisconsin tobacco has not been in so good repute, and has been our less formidable rival, and attention has again been turned towards Connecticut Valley crops; but I understand that now Wisconsin goods are again demanding attention, which shows the fluctuations of trade, and teaches us to endeavor to produce such goods as the trade shall demand.

We must also endeavor to grow our crops at the least possible cost, that we may be able to compete with growers in the neighboring States. Of one thing we may be assured: the increased consumption of tobacco keeps pace with the production; and although we are frequently told by speculators that the production is being overdone, we soon find that the country is becoming exhausted of desirable goods.

In regard to the cost of raising tobacco, in dollars and cents, I shall give the testimony of two gentlemen well known in the valley.

H. S. Porter, Esq., of Hatfield, in a paper read before the Franklin Harvest Club, gave the items of the cost of raising an acre, which amounted to $197, as follows: —

Labor,	$86 00	
Plants, land and taxes, shed room,	26 00	
Fertilizers,	85 00	
		$197 00
Cr. By 1,800 lbs. tobacco at 12 cents,		216 00
Balance in favor of the crop,		$19 00

In this case Mr. Porter used five cords barn-yard manure,

Which he valued at $7 per cord,	$35 00
Also, one ton Stockbridge fertilizer,	50 00
	$85 00

It is a common thing for tobacco growers to use both barn-yard manure and commercial fertilizer for the growth of the crop. Frequently a quantity of the latter is put into the hill, to act quickly upon the plant.

Silas G. Hubbard, Esq., of Hatfield, who has had considerable experience in raising tobacco with commercial fertilizers only, gave me the following statement as to the expense of raising an acre with the fertilizers, and the yield of the crop, as follows: —

1½ tons of tobacco stems at $15.00 per ton, . . .	$22 50	
800 pounds of bone at $35.00, " "	14 00	

To which I also add the same amount as in the first case, for other expenses; viz.: —

For labor, ...	86 00	
Plants, land and taxes and shed room, ...	26 00	
		$148 50
Cr. By 1,500 pounds tobacco at 12 cents per lb. .		180 00
Balance in favor of crop, ...		$31 50

It may be proper here to remark that the price of twelve cents per pound, as the value of these crops, was not the actual price for which these crops were sold, but a supposable price, and perhaps may be considered a fair average price, although many crops are sold for from fifteen to twenty cents per pound, and in some instances even more. A crop of five acres, owned by the writer, grown in the year 1880, brought him four hundred dollars per acre, and many instances could be named where, during the last five years, farmers have received from three to five hundred dollars per acre for their tobacco.

Mr. Hubbard says that the crop, fertilized as above, was fully equal to the crops on land fertilized with barn-yard manure; and, further, that where he used two tons of tobacco stems per acre instead of one and a half tons, the crop gave the best returns.

He recommends the changing of fertilizers in succeeding years; *i.e.*, where he has used a certain kind of fertilizer this year, he will use a different kind another year. The labor account of the different acres would not vary much, excepting as it may be more or less labor to apply the different fertilizers.

It has been a common way with some to hire the crop raised by the pound. I have heard of instances where five cents per pound was paid for the labor, the owner furnishing the land, team, fertilizers and shed room for curing, the employee doing all the work, and delivering the crop in the case ready for sale. Other cases have been where every-

thing was performed in the same manner as above, excepting the laborer received one-half or two-fifths of the crop, as the bargain may have been.

An instance has recently come to my knowledge where, during the past season, an individual paid seventy dollars an acre for the cultivation of the crop, delivered in the bundle. In this case, if the owner were obliged to assort it, it would cost him twenty-five or thirty dollars more to assort and case it, which would amount to about one hundred dollars an acre, which is about an average cost of cultivation.

In the case of Mr. Porter, the 1,800 lbs. of tobacco cost .	$0.109 per lb.
In the case of Mr. Hubbard, the 1,500 lbs. of tobacco cost	.099 "

In both cases nothing was credited for value of manure unexpended, which is often in like instances estimated at one-third of its value.

Whether the land of Mr. Porter was left in a more fertile condition than that of Mr. Hubbard, the writer does not undertake to say.

Any one who engaged in the cultivation of tobacco need not expect to make a fortune by any magic hand; such a lot does not fall to the tiller of the soil.

Although there are instances which the writer could name, where individuals have become wealthy by the cultivation of tobacco, yet the wealth was obtained by untiring industry and frugality, which is necessary to prosperity in any business. If the farmer is able to receive fair compensation for his labor, and a proper income for his investment in land, manure, implements and team, together with a fair addition for risk or hazard, he may be content. There are seasons when the culture of the crop is very remunerating; but the work is a laborious as well as a hazardous one. The crop is liable to a great many drawbacks. Dry weather may make the transplanting of the plants expensive, the cutworm and the green worm may necessitate extreme diligence and patience, a hail storm may in a few minutes destroy the whole work of the season, or after the crop is housed it may be materially injured by pole sweat. But there are drawbacks in any business; such has fallen to the lot of man, and will till the end of time.

Fifty years ago, if one passed through the beautiful

meadows on either side of the Connecticut River, from the State line of Massachusetts on the north to the same boundary on the south, in the month of September, he would see almost one continuous field of broom-corn. Every farmer raised broom-corn. It was their special crop, — the money crop. The river farmers being destitute of pasturing could not make stock-raising profitable; therefore they, following a mixed husbandry, grew corn, rye, oats, grass, and fattened some pork and beef; but broom-corn was their money crop, the avails of which would furnish the means to buy the necessaries of the household which could not be bartered for with other farm produce.

From the broom-corn brush considerable seed was gathered, which, when ground with the other grains, made good provender for swine and neat stock. In the winter the broom-corn brush was tied into brooms. Our neighboring town of Hadley became celebrated for her broom manufactures, while many other towns were more or less engaged in the traffic. There was also a necessary accompaniment, the "Yankee broom-peddler," who, with his one-horse team, traversed the country as far as Canada on the north, Boston on the east (there were no railroads then), Albany on the west, which was then almost the extreme limit of western trade (though we did sometimes hear of some venturesome one who had been out as far as Schenectady), and Providence, R. I., or Hartford, Conn., on the south. Illinois with her fertile prairies was then unknown. Upon the settlement of our western country, and the opening up of her cheap and fertile lands to the cultivation of broom-corn, as well as other crops, the profit of broom-corn raising in New England was destroyed.

It was about this time that the cultivation of tobacco was introduced into the valley; but it was with a mental vision of the thousands of acres of broom-corn waving in the wind like an inland sea, which led the poet of the Bi-Centennial Gathering, at the anniversary of the settlement of Old Hadley (held in 1859), to break out in the chorus: —

> "For the tall broom-corn is a warrior born,
> In stern battalions growing,
> And its green leaves wave like a banner brave,
> When the battle winds are blowing."

I have already stated that the cultivation of tobacco prepared the land for future abundant crops. But, I am asked, How this can be, when the crop is so exhaustive? I answer, by saying, that the tobacco crop is not an exhaustive one to the land; that in the Connecticut Valley the farms have been growing richer; that they are in a higher state of fertility in consequence of its cultivation.

We admit that in the older States the lands have become run out as the result of tobacco growing, but this only shows the shiftless management of the Southern planters. Such may be the case in New England to a small extent, where some parts of the farm have been robbed of their fertility to raise tobacco on a few acres. But I am glad to state, that so far as I know, in this valley the crop is raised in rotations with other crops over the farm. It is true that the tobacco plant is a gross feeder, or, more correctly, requires land in a high state of cultivation to insure a crop, and for the reason that the plant has but a short time in which to mature, and of necessity must find nourishment to push forward its growth; but it leaves the land in a high state of cultivation. For the truth of this statement, witness the enormous crops which follow.

A neighbor cut last season (by estimation) from five acres of land, fifteen tons of hay at the first crop. This was the second year of mowing after tobacco. Another neighbor harvested from one acre, after tobacco, fifty bushels of wheat. Another, from less than two acres, eighty bushels.

Prof. S. W. Johnson in his report made to the State Board of Agriculture of Connecticut, in 1873, page 401, says that "the farmer who should raise a crop of thirty-eight bushels of corn, and sell it and the stalks also off the farm, would export more than goes off in eighteen hundred pounds of tobacco leaves, save what could be replaced by a bushel of lime and a half bushel of plaster." He further says: "Tobacco is commonly reputed to remove from the land a great deal of potash. Hay and potatoes considerably exceed it, though, in this respect, and less potash is required for the entire tobacco crop than for the entire corn crop;" and further, "Clover requires and carries away more lime than tobacco." "The growth of tobacco is a very rapid one,

and the supplies in the soil must be so abundant that the tiny roots can find nourishment at every point."

But it is not necessary to depend altogether upon the testimony of scientific men to substantiate the statement made, that the Connecticut Valley farms are increasing in fertility as a result of the culture of tobacco.

My neighbor, with his farm of twenty-four acres, twenty years since cut less than ten tons of hay annually; but now, with his eight or ten acres of tobacco out of the twenty-four, cuts from forty to fifty tons yearly.

This is not an imaginary case. The owner's name could be given if necessary, but "his name is Legion." Neither is the statement in any degree invalidated because of the fact that the owner of this farm feeds to his animals twenty tons of hay, or one thousand bushels of corn besides what he grows himself. Nor is the statement in any degree shown to be incorrect because of the fact that the farmers of the valley are feeding extensively of corn grown in Illinois, of cotton-seed meal brought from Tennessee or Mississippi, or because of the importations and application yearly to the lands of the hundreds, yes, thousands, of tons of commercial fertilizers in every form and description, or because of the hundreds of car-loads of the excrements of domestic animals, which are annually brought into the valley and applied to the soil. On what other farm crop of the valley is one-half the investment made for fertilizing elements? Who is he who dares to say that this large amount of plant nourishment is to any considerable extent drawn from the soil by the following tobacco crop? Do the succeeding crops of grain or grass show an exhausted condition of the soil?

To show still further the beneficial effects arising from the cultivation of this crop, I can point you to swamp lands that have been cleared up and converted into the best of mowing lands in consequence of the desire to cut more hay as feed to farm stock, and to increase the manure pile.

An aged physician who resides in one of our river towns, says that "the cultivation of tobacco has been the means of raising the health of the town in the sanitary scale of the towns of the Commonwealth, from the tenth to the third, resulting from the opening of the drains to get the muck for compost."

The writer who claims to have an eye of observation is able to testify to the same fact, and rejoices that his native town is able to show so large a number of acres which have been reclaimed within the last few years from their state of worthlessness to their present state of beauty, fertility and profit.

In closing this already too long paper, perhaps it may come within my province, as connected with the cultivation of tobacco in this valley, to speak of the quite recent introduction and alarming increase in the importation of tobacco grown upon the island of Sumatra. As is well known, Sumatra is one of the East India Islands, and lying under the equator; in size the third largest on the earth. At present some considerable portion of it is controlled by Holland, which has commenced the cultivation and importation to this country of tobacco leaf, a leaf which, although very deficient in quality, is remarkable for its fine appearance, and for being admirably adapted for wrapping cigars. It is said that one pound of it will wrap as many as three or four pounds of our leaf, and that manufacturers can afford to use it at a cost of $1.20 per pound. The present tariff is 35 cts. per pound, and 10 per cent., *ad valorem*, additional, which latter ceased Jan. 1, 1883. I understand that there are 40,000 bales, of 175 pounds each, now in Holland waiting for shipment after the expiration of the time when the 10 per cent. *ad valorem* duty ceases to be in force. That the importation is increasing is shown by the fact that the amount brought to this country in the month of August, 1882, was much greater than that imported during the whole year ending June 30, 1880.

The question for us to decide is, whether we are willing that a foreign country shall be allowed to flood ours with a product she is able to raise so cheaply with coolie labor, and which may prove so disastrous to this branch of agricultural industry. We are obliged to accept the situation when the producers of the western part of our own country, with special rates of transportation, become our competitors in our Eastern markets with the productions of their soil. But shall we grant Holland the same privileges? While many of the European countries are closing their doors against the

introduction of our tobacco, shall we allow our industry to be broken down by them? By our own laws of protection to home industries our agriculturists are obliged to submit to heavy taxes upon articles of daily use and necessity. Shall the farmers have no protection? The cigar manufacturer says "The farmer needs none." "When he is driven from the production of one article he can take up another." Is this right?

While the manufacturers are able to raise millions of money to be expended in influencing legislation, shall we be altogether inactive in regard to our interests? Our legislators should act for the people. The agriculturists are in strong majority. Let us be united in our appeals to them, showing them that we are in earnest.

We only ask for such protection to our interests as shall be just and equitable, for such an equalization of all taxes, as that no industry shall be burdened, but protected.

Or in the language of the late Tariff Commission, "See that justice is done to all existing interests."

Adjourned until afternoon.

Afternoon Session.

The meeting was called to order at two o'clock by Mr. Grinnell.

The Chairman. The first thing which we will attend to this afternoon, before the essay on poultry, will be to have a discussion on the question of raising and marketing tobacco. Mr. Thaddeus Graves of Hatfield is one of the largest growers of tobacco in the country. I will ask him to come forward and tell us something in regard to the production of tobacco, and answer such questions as you may ask.

Mr. Graves. I listened with a great deal of pleasure to the remarks made by Mr. Smith. I listened to him with peculiar pleasure, from the fact that I found myself in agreement with him upon most of the statements made in regard to tobacco cultivation.

For the past twenty-five years, the cultivation of tobacco

has been esteemed the chief interest of the Connecticut Valley, and notwithstanding the vigor and force of its opponents, one thing is perfectly clear: It has brought into this valley more money, it has redeemed and regenerated more farms, and has released from their trials and tribulations more of the farmers, than any and all other industries in this valley combined. Of course we understand that the agricultural societies outside of this valley are entirely excusable for not making it a prominent interest; at the same time, I do not see any reason why a competitive examination of different crops of tobacco in this valley is not as important as a similar examination of different crops of corn; and more especially is this important when you recollect that there is no crop raised by man anywhere, one feature of which is so important as it is in regard to tobacco in the Connecticut Valley, and that is this: the selection of the proper seed. The man who has selected the proper seed from which to raise a crop of tobacco has, in my judgment, won half the battle. It is very much so with a great many other crops, but it is especially so with tobacco, and more especially so with Havana tobacco, which is the prevailing kind planted in the valley at the present time. The old seed-leaf tobacco has had a great many friends, but I suppose it is now regarded, even by its friends, as having passed out of the line of vision, and that something else has come in to take its place, which is Havana seed tobacco. Havana seed tobacco is peculiar in this, that, like the little boy, if it is good, it is very, very good, and if it is bad, it is horrid. What I mean to say by that is, that if it possesses the quality which Havana tobacco should possess, and which if proper care is taken in the selection of the seed it will possess, with good cultivation, then you have a fine clear, tough, flexible, elegant leaf, five or six pounds of which will wrap a thousand cigars. If the seed is ten, twelve, fifteen or twenty years old, you will have a large, thin, good-for-nothing leaf, which might as well be disposed of for binders, or for any other purpose for which you can make it available. My judgment is that the seed should never be more than seven years old; I would rather have it less than more; that it should be selected from the very best

quality of tobacco. And here comes in the suggestion that I made, that the agricultural society should take this matter up and make it a matter of competitive examination, so that the chief interest of the valley should be represented in some slight degree, to such an extent, at least, that growers who are unfamiliar with this matter should be able to select the very best seed.

Of course, it is not my purpose to go over the ground that the gentleman occupied this morning. I will pass from this point to another, in reference to which I should question his views a little; and that is, with reference to the time Havana tobacco should be allowed to stand. I believe that to be another vital point in the raising of Havana tobacco. I feel that the bulk of the growers do not let their Havana tobacco stand long enough. I think that the majority of the growers will probably agree with me upon this point. It is in a measure due to the fact that we are expecting frosts and accidents, and, as the gentleman said this morning, we all feel a sense of great relief when the crop is safely housed. All these things tend to induce the farmer to house his tobacco too soon. My feeling is that Havana tobacco should never stand less than five, and from that to seven weeks. You see, if this theory is followed out, it does not make any difference how early you set out the plants; set them out as early as you please. Havana tobacco as a rule is topped as late as the last week in July, and it should not be cut before the last of the first or the first of the second week in September, and within that period we have all known very severe frosts — so that, of course, the farmers feel a little anxious; but my doctrine is that it always pays to make every effort to have a good thing, and if you do not get a good thing, then you may hold yourself excusable. A perfect article of Havana tobacco cannot be got by letting it stand but three weeks after topping, in my judgment.

But, gentlemen, of all the troubles that beset tobacco raisers in this valley at the present time, there is nothing that affects them so seriously as the recent introduction of Sumatra tobacco, which has increased so rapidly that, during each of the months of July and August, 1882, more of that

quality of tobacco was introduced into this market than was introduced during the entire year 1881, so that the very rapid progress of this trade is at once evident to everybody. It comes in under the demand from the manufacturers that arose about the time that a five-cent cigar became so very important and the demand for it became so great. It became necessary that something should be used for the wrapper that would wrap more cigars in proportion to the weight than could be done by the old seed-leaf tobacco. A case of that tobacco, weighing 400 pounds, will wrap, usually, about 20,000 cigars, whereas three or four pounds of Sumatra tobacco will wrap a thousand cigars. It makes a very nice, pleasant-looking wrapper, one that is very tough, and it is always the same. It can always be used up entire. There is no loss, and the manufacturer who buys a pound of Sumatra tobacco knows exactly what he is going to do with it. Now, what is to be done? The interests of the Connecticut Valley, of the State of Connecticut, of the State of Wisconsin, of the State of Pennsylvania, and of the State of Ohio (for all these sections of the country raise wrapper-leaf), demand that there should be protection given them precisely as is given the manufacturer against cheap labor, and against a competition from outside that would be ruinous; for, of course, the raising of tobacco depends entirely upon the number of wrappers that a man raises, and not upon the number of binders or fillers. No man can raise tobacco simply as binders or fillers, because the wrapper sells for about three times as much per pound as the binder, and about five times as much as the filler. Therefore, if the Sumatra tobacco takes possession of the market and furnishes wrappers, all the tobacco that is raised in this valley can be used for no other purpose than to furnish either binders or fillers.

This, gentlemen, is a matter of a great deal of importance to the tobacco raisers of this valley, and not only that, but I regard it as a matter of vital importance. I have a great deal of confidence in the position taken by the farmer who said, that although the simple, unsupported petition of farmers might fail if it was presented to Congress, if each farmer, as he put down his name, would deposit five dollars to see

that the petition was properly presented, it would be very likely to be granted. But another gentleman remarked, very properly, that it would be a very difficult thing to get signers to put down the money. I am afraid that is a peculiarity of our farmers, as a rule. It is not a peculiarity of the dealers, because the dealers in tobacco are as anxious to have Sumatra tobacco pushed out of the market as are the raisers, for the reason that the dealers are not allowed to handle the Sumatra tobacco at all, the whole of it being handled by a German syndicate, who sell it to the manufacturers by sample.

The CHAIRMAN. What are binders?

Mr. GRAVES. The binder is the leaf that wraps the filler immediately inside the wrapper, which is the outside.

Mr. WEST. What would be a fair price for Havana tobacco raised here in the valley?

Mr. GRAVES. I should say that would depend very much upon the quality.

Mr. WEST. Supposing it is good?

Mr. GRAVES. Twenty cents a pound.

Mr. WARE. I confess I feel somewhat puzzled. Mr. Smith presented us this morning with the cost and the value of two crops of tobacco that I supposed were brought forward as premium crops. One was fifteen hundred weight to the acre, and the other eighteen hundred weight—very large crops, as I understand; and in summing up the net profit on those crops, he said that in one case it was nineteen dollars per acre, and in the other forty dollars per acre. Now, Mr. Graves has told us that the growing of tobacco has brought more money into this beautiful valley than anything else that has ever been grown here; that it has lifted the burden of debt and mortgage from more farms than any other crop, and has developed the farmers and the people generally of this valley more than any other interest. I cannot see how so much money has been made and how so many farms have been redeemed from debt by a profit of from nineteen to forty dollars an acre. Why, it seems to me that the profit on a crop of white beans would be more than that, especially this last year. That is what I have failed to understand. If Mr. Graves will please explain, I should be very glad.

Mr. GRAVES. I will do so with the greatest pleasure. I will say, with reference to this matter, that I have on two occasions sold my tobacco at an average of seven hundred dollars an acre, which would be a very high price for beans in this neighborhood.

Mr. WARE. Then where is Mr. Smith? I would like to have him explain his statement.

Mr. GRAVES. Mr. Smith is not here. I will answer the question. The seven hundred dollars which I received per acre for my tobacco paid for all the manure, all the land, and all the labor the first year. I don't pretend that I am getting that price now. Mr. Smith was talking about the crop at the present time; I am telling what the crop has done in the past.

Mr. TAFT. What did it cost you to get your seven hundred dollars?

Mr. GRAVES. It cost me $100 an acre for labor, it cost me $125 for fertilizer, making $225—leaving $475 for my land. That is what tobacco has done, not what it is now doing. I sold that tobacco for thirty-seven and a half cents a pound, all round.

Mr. TAFT. Will you tell us how long it has been since such prices have been received?

Mr. GRAVES. That was in 1868.

Mr. WARE. That was a good while ago. Now, pray tell us how it is at the present time, and whether any farms have been redeemed from mortgages the last few years by raising tobacco.

Mr. GRAVES. Within the past few years the price has very much decreased. It is regarded by those who raise tobacco to-day that it is a very much more profitable crop than anything else, otherwise there would be no plea in its favor.

Mr. TAFT. What is a good crop worth to-day? That is, what do you consider a good crop worth in 1882?

Mr. GRAVES. We call the 1882 crop of Havana tobacco worth sixteen cents a pound, all round.

Mr. TAFT. I mean in dollars and cents per acre. That is what we want to know here.

Mr. GRAVES. Three hundred dollars.

Mr. TAFT. How much is the cost of labor and fertilizer?

Mr. GRAVES. The cost would be from one hundred and twenty-five to one hundred and fifty dollars.

Mr. TAFT. And the balance would be profit?

Mr. GRAVES. The balance would be profit, of course. This would be calculated upon a yield of eighteen or nineteen hundred pounds per acre, and I have just heard of a man who raises twenty-six hundred pounds to the acre.

Mr. SLADE. To what extent do you ask for protection?

Mr. GRAVES. Sufficient to keep Sumatra tobacco out of the market.

Mr. SEDGWICK. If the farmers need protection on tobacco, they also need it on other crops. I raise potatoes for sale. Last year I could have sold my potatoes in New York City, from $1.25 to $1.50 per bushel if it had not been for the importation of potatoes, the result of which was that I had to sell my crop for 90 cents a bushel. I was in a produce house last week in New York, when a customer came in and said, "What is the price of beans per bushel?" The dealer said, "American beans are worth $2.75, but we have got some very fine German beans here for $2.50." German cabbages were imported into New York last winter by the ship-load, and sold for less than our crop which we put on the market. I noticed by a paper last week that one hundred and twenty packages of butter had been shipped from Liverpool to Chicago, because it could be bought for a less price than American butter. Now I say, if farmers want protection (and they ought to have protection, because they sell their products in the lowest market in the world, and pay the highest price for everything they buy) — if they want protection, they must ask protection for other crops as well as for tobacco.

Mr. PAUL. I would like to ask Mr. Graves one question. I understood him to say that the cost of raising an acre of tobacco, when the gross sales amounted to seven hundred dollars an acre, was one hundred and twenty-five dollars for fertilizer, and one hundred dollars for labor. He says now, if I understand him, that at the present time, the cost of fertilizer and labor amounts to one hundred and twenty-five or one hundred and fifty dollars. I would like to inquire if

the cost of fertilizer has been reduced to such an extent as to make that difference?

Mr. GRAVES. I think that with the present experience of tobacco growers, the land can be as well fertilized for fifty dollars as it could be at that time for one hundred dollars.

Mr. PAUL. I am unable to get it at any lower price than I did years ago, and some of the elements of plant food, if anything, are higher than formerly.

Mr. GRAVES. Manure with us is sold at a much less price than it was a few years ago. The price of raising tobacco per acre at that time was one hundred dollars, and it is now fifty.

Mr. S. G. HUBBARD of Hatfield. I suppose I was the man referred to by Mr. Smith in his very fine essay. Mr. Smith was probably misled by me in one statement that he made. He said that I estimated the value of my crop at twelve cents a pound. I was then taking into view the effect of this recent introduction of Sumatra tobacco, which I thought would reduce my wrappers to the condition of binders. But I will say that I have got a very fine crop of tobacco, equal to anything that I have raised for the last three or four years. I am informed that the price has been put at seventeen cents per pound, and there is no reason why my crop should not be worth as much as that, at least. That would very materially modify the statement of the profits.

Mr. SMITH. I meant to make my statement with reference to Mr. Hubbard's tobacco sufficiently clear in my paper. He did not state any price per pound, but Mr. Porter did in his paper, and I understood him to state what was a fair nominal price, and I took the same price for Mr. Hubbard's tobacco; not because he gave it to me, for he did not give me any figure as the price. He gave me the cost of raising, and the amount of tobacco he produced to the acre. I said I presumed it was seedling Havana, and would bring more, but in making the comparison between the two, I put in the same price per pound.

In answer to Mr. Ware, I will say that those two crops to which he referred were not taken as premium crops at all. There were merely representative crops, raised by represen-

tative men, showing the cost of cultivation. That was all that was intended. They were not presented for the purpose of showing the profit of raising tobacco.

Mr. P. L. Buell of Ludlow. The time to which Mr. Graves has referred, when mortgages were cleared from farms through raising tobacco, was during the war. I want to ask the question whether, within the last five years, from the outlet of the river to its source, there has not been mortgage on mortgage placed upon farms in consequence of raising tobacco? When I noticed in the programme for this meeting that the discussion of tobacco was to assume a prominent place, and to be discussed by such a prominent and intelligent speaker as Mr. Smith, I was grieved. Then came this thought: this meeting is to be held in the Connecticut Valley, where a larger proportion of farmers than in any other part of the State are successful raisers, to a greater or less extent, of tobacco. And conceding it to be their right that this discussion should be held here in this meeting of the Board of Agriculture of Massachusetts, I submitted with a good grace; but I do protest in my own mind, having as I do a deep interest in the welfare of the young people of this vicinity and of the State, against this whole thing from beginning to end; but still, I believe that this discussion will result in good. I think that if the question of doing away entirely and forever with tobacco from this Commonwealth and these United States were put to a vote, nine-tenths of the people of this broad land would vote "aye."

Now in regard to the encouragement to be furnished to the young men and the young women who are starting in li e and buying farms, as we recommend them to do, and running in debt for those farms, shall we advise them to raise tobacco in order to help pay for those farms for which they run in debt?

Mr. ———. Will the last speaker give us a list of the crops that can be raised to pay for those farms?

Mr. Buell. There is hardly time to discuss that this afternoon, but I will say this,—and I say it with the fullest confidence in the truth of what I say, — that if our young people will economize, it is as easy, if not easier, to pay for a farm at the present time, by raising the ordinary crops and by the

produce of the dairy, as it ever was in the past, if the family expenses can be made as small as they were thirty or forty years ago.

Mr. West. The question was asked by the gentleman who preceded the last speaker, what crops could be raised to pay for a farm. There are gentlemen present who have had success in raising grass as a crop.

The Chairman. That is a little foreign to the subject. We want to confine ourselves to the raising of tobacco. I don't think the question of morality need come up.

Mr. Myrick. There is one point about this protection against Sumatra tobacco which I think gentlemen who advocate protection for other crops overlook. We can raise corn, potatoes, cabbages and beans, which are imported into this country in such large quantities, everywhere. Wrappers for cigars can be raised only in a limited section. I believe the total product last year was 400,000 bales; at any rate it was a comparatively small quantity. But the point is, that the area on which tobacco can be raised is so small, comparatively, that any considerable importation, at low prices, of any tobacco which will take the place of these wrappers, will put them in the place of second quality tobacco.

Mr. Sessions. There is only a limited section of the country where this tobacco question is of interest. Men who work on hill farms, as I do, really have no interest in this matter, because we are not so situated that we can raise tobacco. But that is no reason why we should object to gentlemen raising it who live in this valley and have land specially adapted to this business; gentlemen whose farms, although they are very productive, and would surpass our hill farms in their products, yet are circumscribed in area. They can make tobacco, as the essayist told us, a crop in rotation, and go over their whole farms, and improve their whole farms. That does not apply to my farm, because my farm is composed of pine plains and hill land, meadow land and pasture land. Let us look the thing squarely in the face. The farmers of this section of the State, the farmers of Pennsylvania, and the farmers of Ohio are particularly interested in this matter. Let us look at it in that light, and not say, because we are not interested, because it does not

touch us, we must not do anything for them. That is the trouble with this nation, and especially with the farmers of this nation. If a question does not touch our own pockets we are not interested in it.

Mr. Fowler of Westfield. We are interested in this question for the very reason that it does touch our own pockets; and this Sumatra tobacco, under the present aspect of the matter, certainly does touch our pockets, because we have not got the goods to put against it, and for no other reason. In my own town there are quite a number of manufacturers of cigars. In looking that town through during the past week I found but one factory where they were using Sumatra tobacco. They had all tried it and did not want to try any more. The fact is, it costs about seven dollars a thousand to wrap cigars with Sumatra tobacco, and fifteen pounds of fair quality of Havana seed will wrap a thousand cigars. That comes pretty near forty cents a pound. If we can raise the goods for the manufacturers, they do not want Sumatra tobacco, for this simple reason: it is good for nothing except to look at. They can use nothing except the wrapper, which is very fine indeed. The cuttings are thrown away — go in with the stems; they are good for nothing except for fertilizing purposes. The manufacturers do not want to use this Sumatra tobacco. Some of them are ready to sign a petition to have a duty placed on it of one dollar a pound; some of them say they do not care anything about it, but if the smokers demand a dark, handsome cigar, we have got to make it for them. We shall have to make it if they call for it, but we hope they will not call for it. Sumatra tobacco is not invariably good. It runs as our tobaccos do — some good, some bad, some indifferent; and it is as difficult to get a good case of Sumatra tobacco, as it is to get a good case of Havana seed. These facts I gather from the manufacturers in our place, and it seems to me, before we jump in too fast or too far, we ought to know what we are doing and what the effect will be. I believe in the statement that we need protection in some things. We do not propose to protect ourselves against any parties living in the United States, that I know of, but I do think, that as long as German and other foreign governments are placing restrictive duties upon the

importation of tobacco, we have a right to ask, expect and demand, that we shall have protection, if we need it. We have simply to show them whether we can raise tobacco or not.

I would like to ask Mr. Smith one question in regard to the use of tobacco stems as fertilizers for tobacco. Whether or not the quality of the tobacco raised upon land fertilized with those stems is up to the proper standard.

Mr. SMITH. I refer that question to Mr. Hubbard of Hatfield.

Mr. HUBBARD. There are some samples of tobacco on the stand grown with stems.

Mr. FOWLER. A buyer told me that some growers had ruined their reputation by raising their tobacco by the use of stems as a fertilizer.

Mr. HUBBARD. Stems from the best seed-leaf that burns white will produce white-burning tobacco. I would like to introduce some resolutions in reference to this matter of Sumatra tobacco.

Mr. Hubbard read a series of resolutions setting forth the facts in regard to the effect of Sumatra tobacco upon the market, and urging upon Congress the necessity of imposing a duty upon it.

Mr. SLADE. I move that the resolutions be laid on the table.

The motion of Mr. Slade was put and declared carried.

Mr. ———. I don't believe in shutting out debate on a question so important as this. There is no question more prominently before the American people than this.

The CHAIRMAN. I think that the debate on this question has gone far enough this afternoon, and the majority of the audience evidently think so too. The longer it continues, the more liable we shall be to get into an uncomfortable state of mind and temper. It will be better to take up our regular order of business; that is, a paper on "Fowls for the Table and Market," by Mr. MASON C. WELD of New York.

FOWLS FOR THE TABLE AND MARKET.

BY MASON C. WELD OF NEW YORK.

Barn-door fowls yield us two noteworthy products of very different character: FLESH and EGGS. I confine my remarks to the former.

Like others of our domestic animals, the fowl in its various breeds has adapted itself in its multitude of varieties to the diverse uses and surroundings of civilized man. We have persistent layers of eggs for those who value this product chiefly. We have the ponderous Asiatic fowls rivalling turkeys in weight. We have those of fanciful plumage, combined with homely utility of one kind or another. We have, besides, breeds so minute, and so useless withal, that their very uselessness seems a merit; and then we have the active and beautiful Games, in great variety,—the thoroughbreds of the dunghill, in which all the excellences of all varieties seem concentrated,—adapted to every useful purpose, excelling in beauty of form, incomparably superior in quality of flesh; without superiors, almost without equals, as layers, setters and nurses, and absolutely without peers in the vigorous and intelligent defence of their young on the part of the hens, and of their flocks of hens on the part of the adult cocks.

Thus it would seem that every farmer should be able to select a breed of fowls exactly adapted to the particular requirements of his own farm and market.

We must not forget, however, that in all pure breeds of animals, from horses to canary-birds, there is a constant tendency to depart from the standard, and as a result, if we would breed pure, the necessity exists for constant care in selection, breeding and rearing of standard stock.

Now, if we are raising poultry chiefly for the table or for market, it would be better if we could adopt a system by which we could produce fowls for which we should need only to take care that they are always in good breeding and growing condition, and fatten readily; for, so far as profit goes, although "fine feathers make fine birds," yet feathers and "points" of the scale are of little or no account either upon the spit, the gridiron or the market stand.

Natural laws are of universal application, and the same laws of breeding which guide us in raising pigs, sheep and cattle, animals raised for their flesh, apply equally to raising fowls for their flesh. What breeder raises full bloods for slaughter? They may be only fit for the shambles, but no one raises them for that end. The grade or cross-bred steer is, for beef, fully equal and often superior to the full-blood. Grade mutton-sheep of the long-wool breeds are hardly to be distinguished from full-bloods even by an expert. If we cross such sheep with Southdown rams, we secure in the progeny the size, quick-growing, easy-fattening characteristics of the long-wools with the superb form and juicy, marbled flesh of the Downs. So too with pigs; to gain the highest profit, easiest and most rapid fattening, quickest growth, and in short a combination of all porcine excellences, we do not seek them in one breed but cross two breeds: the one, that of the female, distinguished for size, constitution and abundant milk; the other close, compact, small-boned, with little offal, and this the male.

In all cases, under all circumstances, everywhere, every time, without exception, with all breeds of every sort of domestic animals, quadrupeds or poultry, full-blooded males should take precedence, and if selected with care for those qualities we most desire we shall be sure to find the characteristics reproduced in the offspring of the first, and confirmed and increased in subsequent generations. Did any one ever hear of a successful raiser of spring market lambs, who used his old merino or common fine-wool ram? I think not. Some use long-wools, some Downs, all use full-bloods, and the result is sure as the spring showers and sunshine.

A certain breeder of my acquaintance is famous for his fine sucking pigs which he sells for porkers, and I suppose he sells a thousand of them annually, perhaps double that number. They are pure white, grow like weeds, weigh two to three hundred pounds by killing time, and his customers think nobody else can raise pigs like them—such quick growers, easy keepers, with little heads and offal, making delicate and excellent pork, abundant leaf-lard, and monstrous hams and shoulders interlarded with fat. What is the secret? Simply this: He has united two dissimilar breeds

and the progeny possess *the good qualities of both*. One of these breeds is the Berkshire, upon which the breeder depends for constitution, abundant milk, size, prolificacy and the quality of the meat. The other is the small Yorkshire, which gives the color, the leaf-lard, the quickness of growth and the smallness of bone and offal.

The natural laws taken advantage of by these lamb and pig raisers are equally at the service of poultry breeders if we know how to apply them.

LAWS OF BREEDING.

The characteristics of a breed become more and more fixed after generations of breeding for the same points. Promiscuous breeding, entirely without accessions of fresh blood, such as takes place on an island or in an isolated district, establishes characters of great persistency, but it takes ages to accomplish it. The most rapid fixing of individual or family physical traits takes place when close in-breeding is practised. Thus families are confirmed in the possession of valued peculiarities which it is sought to establish. When the valued characteristic is reproduced strongly in the offspring, the power or inherent potency to reproduce its like is known as "pre-potency," because it dates back of the individual. Our common, mongrel, nondescript breeds possess this power to a very limited extent. Among poultry, especially in yards bred with little care, the flock soon settles down upon a basis of useful mediocrity or inferiority.

I take pains to indicate distinctly the basis of law upon which the improvement of these common useful flocks depends, because by their improvement the wealth of the State in this class of property may be vastly increased, and because, though it is very easy to state the rules, and not difficult to convince sensible people of their importance, yet without a thorough understanding of the reasons for the rules few people will carry them out. In fact I find it hard to do so myself, though knowing well the reasons. The grades are so fine, so large, so well plumed and so well formed that it is hard to believe that the cocks are worthless as sires, because being of mixed blood themselves they have no power to get offspring like themselves.

It is just so with other kinds of stock; the common farmer breeds his cows to scrub bulls, his sheep to grade rams and his sows no better; or rather, I would say, if he does thus, he is a *common* farmer — by far too common, even in Massachusetts.

AN EXAMPLE.

As a matter of personal experience let me state that I have gone through all stages of poultry breeding. I have gone wild over Bantams, delighted in Hamburgs and Polands, prided myself upon my superb Brahmas and Dorkings; and exulted in the faultless color, form and grace of the Plymouth Rocks. Nevertheless for years past I have taken more solid comfort in cross-bred fowls in which we have sought to combine those traits which in our household we most value, and could not find in any of the pure-blooded breeds. On a foundation flock of Dorking and light Brahma, with a few white Leghorn hens, all fine of their kinds, we crossed first the gray Dorking and gained better bodies, so far as the Brahmas and Leghorns were concerned, smaller legs, more breast meat, with no deterioration as egg layers. We have long selected eggs for hatching from quiet, steady-laying hens, which produced large eggs, and laid large clutches. Eggs of perfect form, with smooth, firm shells, and of large size, are the only ones set, and the result is, that now it is rare that we have a hen in the yard that lays even medium-sized eggs. This flock we have crossed with Plymouth Rocks, and the result gave great satisfaction. The rapid growth of the chicks is remarkable. We were fast abolishing the pink legs and fine toes brought in by the Dorking cross; and though in color many of the chicks revert to that of the black Malays, which is one of the parent breeds upon which the Plymouth Rocks were founded, which gives a lack of similarity in appearance to the flock, yet in form, style, quality of flesh and laying habits, they are very similar and very good.

I am led to speak of this flock on account of the almost universal tendency to disobey law, even though we know it and believe in it. Last spring, instead of procuring two or three pure Plymouth Rock cocks, as we should have

done, we let the matter go, thinking that the beautiful, young cross-bred roosters of our own raising would do very well. Now we see, in the lot of mongrel-looking cockerels and pullets of this year's crop, what a mistake we made. Back they go two or three generations to gray Dorkings and Brahmas for their legs and their plumage; or perhaps twenty generations to the Malays; or they are ring-streaked, blotched and speckled like Jacob's kine; and there are hardly half a dozen with anything like Plymouth Rock or Dominique plumage. Fortunately they were not essentially injured in form, though we have had an unusual number of broken-legged and bent-toed chickens, or those disabled by one accident or another; and, on the whole, have been pretty well punished. I believe this would nearly all have been avoided if we had bred from pure-blooded cocks; that is, the general characteristics would have been maintained or improved, the plumage would have been that of Plymouth Rocks, with a sprinkling of black chickens, and they would have had vigor and discretion enough to have kept out from under the feet of horses and cows, and so would not have been maimed and lamed.

GRADING AND CROSSING.

Repeated crossing with cocks of the same breed grades up a flock of fowls until they can hardly, or can *not*, be distinguished from full bloods. At the same time the excellences attributable to the original mothers of the flock are growing "small by degrees," or disappearing altogether. This indicates the desirableness of taking a rather violent cross just as soon as fixed tendencies are established, and the flock has a thoroughbred character. How many generations will fix the characteristics of the breed it is hard to tell, for breeds vary in their ability to impress their own traits. There must be system in this grading and crossing, or we shall soon have only mongrels of less promise than the old-fashioned fowls with which we are supposed to have started.

In crossing two breeds of marked *dissimilar* characteristics, which have long been bred for different qualities, we are sure to get individuals in the first generation which

combine the excellences, without the defects, of both breeds, and the flock will consist not of a few of such individuals, but they will be the great majority, if not nearly all. This system of improvement is entirely different from that followed in breeding pure, or in seeking to establish a family or a breed. In the latter case we select the breeding stock, both male and female, from those that exhibit most perfectly the form and markings, or "points," of the breed. In cross-breeding or in breeding grades we select the full-blooded male in one case, and both parents in the other, so that they shall present strong contrasts to one another, taking care that points which we especially value are strong in both. Thus we have a right to expect that the points for which we are breeding shall have their strongest development in the young of the *first* generation.

PRACTICAL POINTS.

Thus in breeding fowls for the greatest weight at the earliest stage at which chickens can be marketed as roasters, we take Asiatic cocks, say Brahmas, and hens of some large but more compact breed, especially those with some strength of wing, for that accompanies a good development of the muscles of the breast, — the best meat of the fowl, such, for instance, as Dorkings or Plymouth Rocks, or one of the excellent French breeds.

If, however, we breed for quality of flesh and good size, which in market fowls is always desirable, we should take a Dorking cock, or perhaps one of the French breeds of similar characteristics, and breed him to large game hens. Thus the size will be fair, growth will be moderately rapid, and the *goodness* of the flesh most remarkable. The bone and offal will be small, and the flesh laid on most abundantly on the choice parts. While for one's own table such fowls would be much preferable to the larger kinds having a lower quality of flesh, for profitable sale they would need to be sent to a discriminating market. Such a one might be created in a few years if the quantity of poultry marketed would warrant it; and, after a few years, fowls of this high quality of flesh would be more profitable to raise than larger or coarser ones.

I speak of using pure-bred hens only because I wish to indicate their characteristics more clearly. A full-blooded cock, say a Brahma, bred with common hens, produces in two or three generations such an entire change in the flock that we may regard the hens as pure Brahmas for all such purposes as we require in breeding cross-breeds. So it is, also, with all the other pure breeds.

We have too few facts upon this subject to enable us to give positive advice in all cases in regard to crossing, and the use of particular breeds for special ends. The broad principles which I have endeavored to set forth are sure.

Some five years ago, perhaps in 1876, a special prize was first offered by the Queens County (N.Y.) Agricultural Society for the best coop of cross-bred fowls bred for flesh. It was won that year by a fine coop of chickens, raised by crossing a Plymouth Rock cock upon light Brahma hens. Those chickens, hatched in the same brood with pure Brahma chickens of fine quality, and which proved prize winners at the same show, soon outstripped them in growth, being superior in size, weight and quality of flesh. The prize coop were not capons, but others of the same stock were caponized, and proved themselves very superior. This is, however, only a single fact, which has its chief interest in this, that it tends to confirm the theory.

The breeder of the coop of cross-bred chickens referred to — a valued personal friend, having had more experience in cross-bred fowls than any one else I know — was applied to by me for information in regard to this matter, and I note his views as follows. He has experience with the following crosses, viz.: —

Light and dark Brahmas, and reports the progeny mealy colored and unthrifty.

Light Brahmas and Plymouth Rocks — progeny first-class as to early maturity and size.

Light Brahmas and Partridge Cochins — progeny first-class, and possessing a superior tendency to fatten.

Partridge Cochins and Black Spanish — progeny mature early; are plump in form, and are fine layers.

Plymouth Rocks and Houdans — progeny possess the same characteristics as the preceding cross.

Plymouth Rocks and Brown Leghorns — progeny make fine broilers and extra good layers.

Houdans and light Brahmas — progeny very symmetrical, plump and precocious.

Silver-spangled Hamburgs and light Brahmas — extra good layers; very symmetrical, but do not mature early.

Silver-spangled Hamburgs and Houdans — progeny extra good for broilers and for eggs.

He states also, that, as a rule, the male influences the color of the progeny, and the female influences the form of the body, bone, etc.

Of all these cross-bred fowls, the Plymouth Rock and light Brahma cross made the fastest growth. They were the heaviest at three to five months old; but pure light Brahmas hatched at the same time were heaviest at nine months old or older, and the pure light Brahmas made the heaviest capons.

Virgin cocks are superior to capons up to about seven months old; after that the capons are superior. They can be made fat at five to seven months old, and capons at seven to eight months; though for their full development nine to twelve months are requisite.

Capons should be marketed when fat, though the market is better after the bulk of other poultry has been consumed, and when game is no longer in season.

ENGLISH EXPERIENCE.

The offer of prizes at the English poultry shows, for chickens bred for quantity and quality of flesh, is attracting attention in Great Britain to such experiments as those just referred to; and, judging from the tone of recent newspaper articles on the subject, great advantage to those who raise poultry for market will certainly result.

The "Field" of September 30 makes the following statement: —

"The prizes for chickens, in which quality and quantity of flesh, absence of waste or offal, and smallness of bone, are the leading characteristics, were in the first instance offered by the proprietors of the 'Field' at the Crystal Palace

Show.* The example has been very generally followed, and we now have classes for cross-bred table fowls at many of our large exhibitions.

"As the regulations say that the sex and breed of each parent must be stated, some very important information will be given to the public at large as to the relative influence of the two breeds employed as progenitors. Thus, the description 'Game Dorking cross' will not be sufficient; but it must be distinctly stated 'bred from game cock and Dorking hen,' or *vice versa*. As very different results arise in the two cases, the information is valuable. Every one recognizes the distinction between a mule and a hinny, which are produced from a mare and a female ass respectively; and experience has shown that cross-breds, the produce of a Dorking cock and game hens, are superior in size and amount of flesh on the breast to those bred from a game cock and Dorking hens.

"The tendency of these classes must be useful, as they will enable breeders for the market and for home use to select the breeds that will most surely produce the desired result. Hitherto the experiments have been generally made by crossing Dorkings and Asiatics, which necessarily produce large-sized chickens. The game crosses, though not so large, have smaller bone and fuller breasts. Dorking crossed with Houdan produce good table fowl, but the useless fifth toe is not eliminated. The crosses of the other French breeds have not yet been largely exhibited; but those from the Crève Cœur and La Flêche should produce results not only valuable as table fowls, but as producers of an ample supply of large eggs."

Mr. W. B. Tegetmeier, perhaps the best known writer upon poultry matters in the world, was judge of this class at the dairy show at Islington, held the first week in October last.

He had no less than twenty-four coops presented, all of which, save one, conformed to the conditions, and named the breed of each parent. He complains, however, that he

* This no doubt means the Crystal Palace Show of last year, 1881, and indicates that the prizes offered by the Long Island Society antedated this by four or five years.

was obliged to pass nearly one-third of the coops, many of them very fine otherwise, because one or more of the birds had crooked breasts.

This is a great disfigurement to market poultry, especially to fowls and turkeys. It comes from roosting on too narrow perches, or from having soft bones, or from both causes; and it is certainly right that crooked-breasted fowls should be disqualified from competing at such shows. Mr. Tegetmeier awarded the first prize to a pair of pullets bred from a Dorking cock and game hen, and another pair bred in the same way were highly commended, but were not in condition to be exhibited as table fowls, as one of them had just finished laying her first clutch of eggs.

The second prize went to a pair bred from a Dorking cock and Houdan hens. Mr. Tegetmeier says: "As they were purely white, the cock was probably a white Dorking. They possessed small tufts and beards, with small combs, moderate bone, were fine in quality, and good in breast."

He speaks of a fine pair, one of which had a crooked breast, bred from a Dorking cock and black Hamburg hen, as being "small in bone, meaty, and of good quality," and as sure to have been prize-winners had it not been for the defect spoken of.

The third prize went to a pair of cockerels bred from a game cock and Brahma hen. "They were plump-breasted, heavy birds, with white skins, though their yellow shanks and length of legs were against them. The crosses between Brahmas and Dorkings were numerous. The white Dorking cock and dark Brahma hen gave rise to a pair of handsome white pullets, that were commended, but their size was deceptive, the feathers being very loose. The cross of Brahma and Dorking produces large birds, coarse in the bone, fluffy and soft in feather, tremendous in size of the legs, and correspondingly poor in the chest; size is gained, but quality is wanting. A Malay cock and Dorking hens yielded a pair of pullets that were commended. Partridge Cochin cock and game hens produced birds with small breasts, and indifferent quality." He adds: —

"The inferences that I think may be drawn from this interesting class are obvious. The first is, that the French

are right in repudiating all crosses with large, coarse-boned Asiatics, as Brahmas, Cochins, and Langshams; big thighs and bony breasts are the result. If Dorkings are used, the cross should be between a Dorking cock, and a small-boned hen of a large-breasted flying breed, as game or large Hamburg. The exhibits in this class distinctly showed that the Dorking should be the male parent. In conclusion, Mr. Tegetmeier says: —

"The testing of the merits of table poultry is not complete until the birds arrive at their destination — *on the table*. This is the touchstone to which I always submit my crosses, and prefer, if possible, comparing two roast birds of different breeds on the same dish," etc.

Certainly nothing is more reasonable. We test a draught-horse by the load he will draw, roadsters and race-horses by actual performance, dairy cows by the pounds of milk or of butter actually weighed; so, where quality upon the table is the test, let the breeder at least actually know by the table test. Such a test might, indeed, be made the occasion of a social gathering of uncommon interest in a neighborhood where several yards of cross-bred fowls are raised.

BROILERS.

There can be no doubt but that the most delicious form in which the flesh of chickens or fowls can be presented to the epicure is when broiled at about three months old or older. Chickens ought not to be taken up for broilers before they weigh a pound each, and three pounds to the pair is still better. If they can be sold by the pound, of course it may pay to make them weigh this; but if the price is by the count (by the pair or dozen), smaller ones will bring a better proportionate price, in all probability. The best broilers are cross-breeds between game hens and Dorking, French or Plymouth, or some similar good-fleshed cocks. This is a difficult cross to make at once, because game hens are not easy to get in number sufficient. The reverse cross is good, but not so good. The hen seems to impart quality of flesh and bone, and to place the flesh where it exists in her own breed. The crosses recommended for roasting chickens, for the autumn and winter market, namely, Dorking, French

or Plymouth Rock hens, with Asiatic cocks and game cocks, on the cross-bred pullets of the first or second generation, make capital broilers, and could be depended upon, with care in raising and marketing, to build up the reputation of any farm.

Broilers are usually marketed alive. The best shipping crate has close sides, the bottom slatted, and a full inch in the clear above the ground, the sides descending past the slat bottom so that the crate rests on them. Thus the ordure falls through, and, if a chicken's leg gets through, it will not be hurt. They should not be crowded overmuch, should have water supplied by one or two old fruit cans in the corners, and a broad slat having thin laths on each side of it may form a sort of pan on the top for feed. They soon learn to crane their necks and eat out of it. If bred solely for the table, that is, not for sale, the more game blood on the hen's side the better; and for the cock one may choose between the French breeds and the Dorkings.

I would put a good large game cock at the head of a flock of common hens one year; the next year I would breed him to his own daughters, for thus I would secure the greatest degree of prepotency. Then, — though the next cross would no doubt give better results, — I would set off a flock for raising broilers, and would use, say, a pure gray or white Dorking of large size, with the grade game hens and pullets produced as described. I have raised such birds. They are large, or at least above medium size, small-boned, heavy, full-breasted, built like a partridge, thrifty, great feeders, easy keepers, always ready to be taken up for the table, though perhaps not fat, and as broilers the best, by far, that I ever picked the bones of.

I have no doubt that, for market, a crossing of larger breeds may make more profitable returns, unless, as I have already intimated, a very discriminating market has been formed or found.

"FALL CHICKENS."

There is a period in the life of a chicken when it is too big to broil and not fat enough to roast; when, for our own

use, we prefer to let it go on living and growing for a while, and take an old fowl for the table, which, roasted if fat and not too old, or boiled or fricaseed if it has reached an uncertain age of probable toughness, nevertheless makes capital soup, at any rate, and probably a very tender, savory dish besides, if well cooked. There is a time every autumn when the market is nearly bare of poultry, and then plump old hens, not over two years old, nicely dressed, sell very well; and, if buyers know how to treat them, recognizing the fact that they are "no chickens," there will be no hard feelings towards either breeder or poulterer.

It is hardly necessary to call attention to the fact that chickens are of two sexes; nevertheless, in most farm-yards, and indeed in most poultry yards, they are treated as if they were of the neuter gender.

This is a mistake. As soon as chickens make the discovery themselves, the cockerels ought to be separated, given a coop with a large, roomy yard, and well fed. The time is indicated with sufficient accuracy by their getting their voice, crowing no longer in the hoarse way of ambitious chicks, but with the tone and ringing accent of "bold chanticlere."

Such cockerels, as soon as they get their full plumage, fatten readily, though they grow rapidly, and do not become really very fat before they nearly gain their full growth. They make, when well fattened, the so-called "virgin cocks," so much prized by epicures, and really worthy to be ranked as equal to capons, or fat pullets, of the late winter and spring.

If the cockerels kept by themselves will bring a higher price at Christmas, or before, it will certainly pay to coop them, for the rest of the flock do much better for their absence. The separation will occur when the hens are getting through their moulting, when, if well fed and not fattened, they will soon begin to lay, and pullets often follow suit.

It does not pay to market pullets while there are plenty of cockerels in the market, for they are much smaller and no fatter, and most buyers take them for small hens; hence it is best to give them the same kind of food as the laying

hens, food upon which they will thrive and grow, but not fatten: barley, buckwheat, oats, wheat screenings, etc., and some scrap-cake, never giving all they will eat; and at evening, just before they go to roost, and at this time only, *hard grain*. We must not forget the young roosters which we have corralled, but will return to the pullets in January, or after their brothers are marketed.

FATTENING.

When attempting to fatten young fowls, it will be found that some take on flesh and fat much more rapidly than others; and when fat, and no longer showing that they gain from day to day, it is time to dispose of these, and go on fattening the others. This is true of capons, as it is of virgin cocks, and it is particularly true of the latter. After a fowl is well fattened, if not killed, it will soon begin to fall off, and will never be so fat again, or certainly not for several years.

The feed of the young fowls in the fattening coop should consist of a reasonable variety, for the sake of tempting their appetites, and at evening some hard grain should always be fed. This is in order that their crops may remain full nearly or quite all night, and that the fowls may remain longer upon the roosts. A fattening fowl's only business is to eat, drink and sleep. If they are hungry at four o'clock, and are watching for the first streaks of morning light so that they may be out foraging, and if, in the frosty autumn mornings, they are hunting about for an hour or two before they are fed, for something to appease their hunger, they will not take on flesh very fast.

In England, and on the Continent, poulterers buy up country poultry, and put them up to fatten in establishments of their own. In these, fowls are fed according to the secret rules and notions of the proprietors. Barley and oat-meal, rice, Indian-corn meal, cooked, wet with milk, and occasionally mingled, while hot, with beef or mutton tallow, are the chief articles of diet. Chopped carrots and parsley roots and leaves, cabbage, celery leaves, etc., are given occasionally, and regular doses of pepper-corns or cayenne pepper to stimulate their appetites.

Such fowls are often crammed, an operation to which fowls readily, not to say cheerfully, submit. This is done by having the soft feed, such as I have just named, of such a consistency that it can be formed into masses called "crams," as large round and half as long as one's finger. These are dipped one at a time into milk or water, and dropped into the mouth of the chicken, which is held open to receive it. The mouth is readily opened by pressing the sides of the bill between the thumb and finger. The chicken usually swallows the crams if they are not made too large; but it does not seem to object to having the morsel aided in its downward course by the little finger, or by gentle pressure upon the gullet. Crammed fowls are fed morning and evening only; kept, a number together, in slatted coops; never fed if any of the previous meal remains in the crop, and, if well fed, will be fat in two weeks. Chickens thus artificially fattened are very attractive on the market stands. Fashion, in England and France, favors white-fleshed fowls, and the theory is that white feed (rice, milk, tallow, barley meal, etc.) makes white flesh. This may in some way affect the appearance, but I doubt if it affects the color of the flesh and skin perceptibly. In this country yellow-skinned fowls are preferred. This much I know, that the flavor of such poultry does not compare with that of those which have an open-air run, and pick up their own food. The practice of cramming is one to be deprecated. It is not economical, and improves neither the nutritive quality nor the flavor of the flesh. The attractive appearance of the dressed fowls is, no doubt, in part due to their having taken no exercise for several days, but more to the perfect way in which they are killed, dressed and displayed.

Fattening fowls should not have a large run. They should have free opportunity to stand in the sunshine, to dust themselves to their heart's content, to scratch and run about. They should have pure water to drink, and pulverized charcoal should be part of their regular diet, it being mixed with their soft feed every two or three days, in quantity enough to blacken it somewhat. The charcoal should be of all-sized pieces, from that of wheat grains down to dust. Its effect is to regulate digestion and the bowels, to

prevent disease, and to promote fattening, indirectly. The effect, however, is so *direct*, that is, immediate, that it is difficult to believe the *fact* that the charcoal has not really nutritive value.

The feed of fattening poultry must be such as can be economically obtained. On a Yankee farm, Indian meal suggests itself at once as the most fattening and the most economical feed; so it probably is: certainly there are few better forms of food than scalded Indian meal. However, corn-meal is very concentrated nourishment, and it is more economical to feed it somewhat *extended* than pure. Small potatoes, washed and boiled and mashed, while hot, with meal, or even with meal and bran (wheat or rye), or middlings mixed half and half, make excellent and very fattening feed. If to this we add some mutton tallow or any other cheap fat, the fattening effect will be greatly increased.

Pork-scrap cake soaked, chopped up, and mixed with this feed is an excellent addition, but must not be fed too freely. A pound of scrap to a dozen fowls every second or third day is enough.

In the winter, cabbage leaves, carrots, beets, celery and parsley leaves are relished, and give no unpleasant flavor to the flesh, but probably the contrary. Onions are highly relished, but should not be fed within several days of killing time, and never to laying hens.

In a fattening house the roosts should be low, to prevent the fowls bruising themselves when they fly down; an inch and a half broad, to prevent the breast being dented or bent; and stiff, to prevent sagging under the weight of many fowls, or swaying or teetering. The house or coop itself should be warm, well ventilated, and roomy enough to permit a person to go all around among the fowls to lift and handle them. This they will submit to with good grace, after two or three times; and it is the only good way to get a thorough knowledge of the condition of the flock, and to select those fit for market.

Fowls well fed will fatten in about three or four weeks in September and October. After cold weather they require more food to hold their own than would fatten them earlier. However, if closely confined in feeding-coops, — which

should have slatted bottoms and be kept scrupulously clean, — they will keep one another warm, and really create an October temperature.

All fattening poultry which do not have a free run must have gravel fed to them every few days, and they should have water daily. It is best to take the chill off in cold weather, and charcoal is not to be forgotten. Salt, also, is at times, in small quantities, highly beneficial. Feather plucking and eating, which is noticed in some flocks occasionally, is usually stopped by feeding small quantities of salt with the soft feed.

KILLING AND PICKING.

A chicken is well killed when the tips of the wings and the legs are held in the hand, the head cut off with an axe, and the fowl held still until its struggles are over. It will bleed well, and not be bruised. A much better way, however, is to hang several chickens up by the legs, which is most easily done by drawing the legs down into long, narrow slots sawed in upright boards, so narrow that the feet will not draw through; and then, to cut the veins and arteries in the back of the mouth or throat with a long, slender knife, — a good-sized pen-knife will do, — the point of which, as a *coup de grâce*, is thrust into the base of the brain, which lies in close juxtaposition to the veins which must be cut. The fowl is thus rendered instantly unconscious, and may be plucked, or at least the plucking may begin at once, without the least cruelty.

Nothing is worse for the flesh than to chop off the head, and then to throw the bird upon the ground to spring and flop about until life is extinct; bruises occur, which, though at first they may not show, become discolored after a while, and prevent the fowl keeping sweet a long time.

Dry-plucked fowls are best for shipping, and best for keeping. They usually bring a higher price, and always ought to. The sooner they are plucked after they are killed, the better. The feathers are much more easily removed, and the skin looks much smoother and fresher than when plucking is delayed until the fowl is nearly or quite cold.

Every one who sends much poultry to market should endeavor to have a way of his own for dressing his poultry for market. He may prefer to market it undrawn, and with the heads and legs on; or he may take a fancy to go to the other extreme, and send it French fashion, all ready to be stuffed and spitted or laid in the roasting-pan.

A recent law in the State of New York, not yet enforced, so far as I am aware, requires all domestic poultry to be drawn before it is sent to market.

I have held that, if fowls are starved for twenty-four hours before killing, it is best to leave them undrawn, and with heads and legs on, and that thus they will keep sweet longer than if drawn. If, however, they are to be drawn, the head should be cut off, a small slit made in the skin of the neck behind, the crop drawn out through the neck, without making any incision in the breast, and the entrails removed through a small cut in the abdomen. The carcass should be wiped out, and the gizzard, heart and liver returned. The skin is then drawn over the neck and tied neatly, or, better, pinned in the back of the neck with a very small skewer.

In the French markets one sees fowls beautifully trussed, and, to all appearance, ready for cooking. It is a taking style, and would, no doubt, prove very attractive here among private customers, if not in the open market. The neck of the well-drawn fowl is crowded back into the breast, and the skin drawn and tied or pinned over it close. Then the ends of the wings are bent under the shoulders, and made to lie flat upon the back. This gives a great expansion to the chest, and throws the whole breast of the fowl up, while the wings under the back lift it up, and show the whole fowl off to the best advantage. The legs are removed, and the skin, which is quite loose in a dry-picked fowl, is easily drawn over the thigh joints, while a little steady pressure on the "drum-sticks" shoves the thighs and "second joints" up under the skin until the ends of the drum-sticks and the tail can be tied together. Even a thin fowl prepared in this way looks plump and attractive, much more one well fattened. When exposed for sale, if there is an abundance of abdominal fat, the golden leaves may be

loosened on each side and turned out, thus nearly closing the opening, while the liver, heart and gizzard may be laid or tucked under the wings on each side.

Fowls dressed in this way ought to be packed on their backs in trays, so that they will not press one another out of shape. The trays might be packed two or three deep in boxes, an abundance of straw covering the fowls, and so, I have no doubt, shipped a great distance in cold weather.

These ways of dressing fowls for market are not favored by poulterers. They prefer to receive the fowls from a distance, packed in boxes or barrels; well cooled of course before packing, and shipped in cold weather. If not frozen they can be moulded into shape, and are really very good. Nevertheless, "barrel poultry" cannot be so good as that which is not close packed. In mild weather it gets a close, "sweaty" odor, and a similar flavor penetrates the flesh. Poultry once affected in this way never looks fresh again.

The method advised by New York poulterers is, to use boxes that will hold about one hundred to one hundred and fifty pounds of poultry, and pack the fowls, killed with the heads on and dry picked, of course empty of feed and stone cold, on a good layer of clean straw, backs up, heads under one wing, feet straight out behind, and in regular rows as close as they can lie; the second layer being placed directly upon the first, with straw all around against the box but not between the fowls; and so on.

Poultry is not hurt by freezing, but will not keep long after it is thawed out.

CAPONS.

As to capons, I would say, that though I have not had large experience, yet I am decidedly of the opinion that too much is ordinarily claimed for them. Poultry raisers, among whom there certainly is a reasonable number with epicurean tendencies, almost universally prefer to sell rather than to eat them, while a fat cockerel or pullet is quite as highly esteemed for their own tables. Too much is claimed both as to the quality of their flesh and the profit of raising them. To my own taste virgin cocks seven or eight months old and well fattened are quite as good eating and are raised with

much less care and expense of food. Capons are about one-third larger, one-fourth to one-third heavier, one to three months older and much fatter, though no more juicy nor higher flavored. Fine cross-bred cockerels which have been kept by themselves from infancy, will weigh at seven to nine months old six to eight pounds; capons of equally good stock at nine to twelve months old should weigh eight to eleven pounds. The latter weight is very seldom reached, and six-pound capons and those still lighter are very much more common.

Most people are disappointed when they first try to raise capons, and after a year or two give it up. There is very little trouble about caponizing the chickens. I have never done it, but several of my friends practise it, having entire success, and not losing more than one per cent. The only advice given me in regard to attempting the operation, and which I think is very judicious, is, *first*, to know exactly what I am going to do, *second*, to practise upon a dead chicken exactly as if it were a living one, and *third*, to carry out my knowledge and experience.

Pullets may be caponized as well as cockerels. They are known as hen-capons, or by the French name *poulard*, and are esteemed as a little better than capons, as the beef of a barren or spayed heifer is thought better than that of steers; yet it may be questioned whether the superiority is not more fanciful than real.

The young caponized fowl, operated upon at about four months old, is set back some weeks in its growth. This back-set is obvious only on the careful comparison of capons with cockerels of the same age, for it soon gets about, feeds and apparently enjoys life as well as ever. Nevertheless, it does not grow so thriftily for some time.

If let alone to run with the flock, as soon as they develop strongly their emasculated character they become the butts of the yard. They are knocked about by the cocks, abused by the hens, and shunned and driven by both. Thus they are always on the outside of the flock, or off by themselves. They are enormous eaters, run their flesh off, and will never get fat.

If, however, they are cooped by themselves and fed as

soon as they begin to show that they are singular, and are well "out of the pin," as it is called, when they get their full plumage, they will fatten with considerable rapidity, but they grow first, and they grow so very fast, often, that they have no time to get fat, at least not very fat. After a while they gain weight very rapidly, and will become exceedingly fat. When this rapid fattening begins, or when the time arrives, experienced breeders usually place those birds which are ready in fattening coops or cages, such as previously described, and force them with all rapidity. They gain fast and become enormously fat. They will hold this condition only a short time, say about ten days; then they begin to fall away and can never be made fat again.

Capons are occasionally seen in the New York and Philadelphia markets which weigh twelve or thirteen pounds, and when hung up will measure more than three feet in length. These markets are largely supplied by the farmers of Bucks County, Pennsylvania, who have as the common fowls of the section a mongrel race known as the Bucks County breed. It is no doubt an excellent breed as a basis for raising cross-bred chickens for capons, but I doubt if it would prove better than Plymouth Rock fowls, or direct crosses of other large breeds.

Capons are almost universally marketed dry plucked, undrawn, with heads and legs on, and with the feathers of the upper part of the neck, the tail and the last joint of the wings left on. This is done to show what they are, the neck hackle feathers proving the sex, and the undeveloped or imperfectly developed tail feathers showing one noticable feature of the capon. They are packed for shipping with their heads, neck and tail feathers protected from dirt and injury, by being wrapped in papers, so that when exhibited on the market-stand the feathers shall be cleanly and unruffled.

FATTENING PULLETS.

If it is worth while to fatten pullets for market, the breeder ought to be sure of ready sale for them at high prices, for a fat pullet that has never laid is a real delicacy, and ought to be paid for accordingly. A few pullets in every yard will begin to lay early, and in this respect there

is a great difference in breeds and crosses as already indicated. Feeding may force them into laying, which would reduce the profit of fattening them probably to nothing, besides offering another source of profit, which it might be worth while not to neglect. Still many would fatten rapidly and never think of family cares and responsibilities. The time to begin feeding is as soon as they are in full plumage, unless it is desired to let them assort themselves into early layers and those which will not lay early. Those selected for fattening are best confined in warm houses about Christmas time, or after other fowls are marketed; say, before the middle of January. Thus they will be fit for market about the time that game is outlawed, and when prices of poultry are at the highest.

In the market they may be distinguished from old hens not only by the softness of the legs and feet, and the tenderness of the point of the breast-bone, but by their undeveloped combs and gills, or wattles; hence it is important to dress them with the heads on, and to ship them in the nicest and most perfect manner.

In conclusion, allow me to say: Use good blood and make the most of it; and to repeat, use full-blooded cocks to grade up common stock until the full-blooded or thoroughbred characteristics are established, and then take a rather violent cross for a fresh start. I believe that this is the best way to improve the common fowls of the State, and that there is as great or greater profit in raising fowls for market as in any other employment of the New England farmer. It is, and will probably continue to be, a small matter as concerns each farmstead, but of immense importance in the aggregate. After a flock of fowls reaches the number of three hundred to five hundred, the danger from contagious diseases increases at a fearful ratio, and so, as it were, by common consent, flocks are kept small.

I must really ask pardon for the imperfect manner in which I have presented this subject, which certainly is important as having obvious practical relations to the profit and experience of every farm, and I hope that some of the hints given may be of service in securing better poultry either for your own tables or for the market.

Mr. SHEPARD. Will the gentleman please tell us how to cook an old fowl so as to make it tender?

Mr. WELD. An old fowl boils very well. If it is well boiled, it is very good eating. I prefer chicken.

Mr. SHEPARD. We all do. I did not know but you could tell us how an old fowl could be made tender.

Mr. WELD. I am not a professed cook, but I know that I often eat old fowl that is very good, and it makes a good soup; there is no doubt about that.

The CHAIRMAN. Cut it up, stew four hours with a good piece of salt pork, and turn it on to some toast in a dish. That is the way to do it.

Mr. SHEPARD. We have done that year after year, and the old fowl will be tough.

The CHAIRMAN. They are better than chickens if you cook them long enough.

Mr. WARE. I will tell you how to cook an old fowl, and keep it whole, and have it very nice. It should be put in no more water to boil than will leave enough, after the fowl is cooked until it is tender, to make a rich gravy; because, in boiling a fowl, or any other meat, the goodness of the meat is drawn out into the water; and if you have a great deal of water, enough to cover it, for instance, you get all the goodness out of the fowl, and the water, unless you use it for soup, is thrown away. The secret is, to have only water enough, as I say, so that when the fowl is done, the water remaining shall be only sufficient to make a good gravy. The length of time it should be boiled depends upon how tough the fowl is when you commence. A piece of pork should be put in with the fowl to boil. Of course you must have a tight cover over the kettle while it is boiling. I don't know but a chicken may be better, but an old fowl that has been well fed, cooked in this way, makes a very excellent dish.

Mr. SHEPARD. Old fowls have a disagreeable odor. I think it is the oil coming out. I did not know but there might be some way of boiling out that oil and getting rid of it.

Mr. WARE. You want to start with hot water.

Mr. ———. I understood the speaker to say that a cross of brown Leghorn and Plymouth Rock made excellent broilers. I wish to ask if hens of this cross excel as layers?

Mr. Weld. I don't know a great deal about that. I was quoting a friend of mine. I think he did not mention them especially as layers.

Mr. ———. I would like to ask the speaker one question in reference to crossing. Supposing I have a flock of Leghorn hens, and want to cross them with the Plymouth Rock; I get a Plymouth Rock cock, and put him in with the Leghorns, and keep them together one season. The next season I wish to make another cross with the same hens, and I get a Brahma cock. Now, does that strain of Plymouth Rock remain in those hens, or will the cross be perfect with the Leghorns and the Brahma after they have had one season with the Plymouth Rock?

Mr. Weld. I don't think you will notice any effect of the crossing of the Plymouth Rock at all when you come to breed a Brahma cock to the same hens. I am sure you won't; I have never seen anything of the kind.

Mr. Shepard. You spoke of crossing the Houdan and the light Brahma. I would like to ask which way you would cross; by using a light Brahma cock, or a Houdan cock? Which makes the best cross?

Mr. Weld. You will get the best fowl for flesh by using a Houdan hen and a Brahma cock. No doubt about it.

Mr. Hadwen of Worcester. I was very much gratified with the essay, and, in my own practical experience, I have proved a good many of the statements that have been made. In regard to the crossing of fowls which was mentioned, I will say that it is quite important to select fowls that have some of the same characteristics. For instance, you would hardly want to cross the game with the Brahma, which are very unlike. It would be better to cross, perhaps, the Leghorn with the Plymouth Rock, both having full breasts and not too much of leg. There is no doubt that in selecting fowls with nearly the same characteristics, you will get a much more desirable cross than where you select fowls that are radically different. I think, in raising poultry for the farm, the old practice of changing the cock every year is a good one. Where you are breeding poultry merely for the flesh and the eggs, it seems not only to give good flesh, but a good quantity of eggs. Where you are breeding poultry with the purpose of keeping a pure breed, and desire an

exact type in each fowl, then you have got to pursue an entirely different course. You have got to select your fowls of a certain type, and breed to a certain strain. These strains, if selected with care, are always beautiful to look upon; the feathers are pencilled alike; and, by occasionally putting in a bird that is not closely related, you can bring out fowls of distinct breeds and strains. I have myself, in breeding the game, bred poultry so nearly alike that you could take a dozen pullets six months old and you would not be able to distinguish one from the other. But this requires a great deal of care, very close selection and breeding, and weeding out, in order to bring poultry or any other creature to a uniform type.

The CHAIRMAN. If there is nothing more to be said on the subject of poultry, we will next take up the very interesting question of barbed wire fence, on which Mr. Henry M. Smith will read a paper.

BARB WIRE AND THE FENCE QUESTION.

BY HENRY M. SMITH, WORCESTER, MASS.

The average farmer or land owner designing to build a fence does not ordinarily deem it needful to search among historical facts and statistics for the solution of his special needs. He builds a fence because he accepts the fence as necessary, and only cares to decide as to material and construction.

But the fact that fencing is one of the first questions in land possession rests upon something wider than individual needs and decisions as regards his own property. Though these broader considerations may lightly occupy the attention of the actual fence-builder, and he yields to the practices they have created, yet the fence question has a meaning and value with all who have responsibilities connected with farm property and progress. A representative body, like the gathering of the Massachusetts Board of Agriculture, with a past record of investigation touching all the topics of our husbandry, long ago found the fence question one of the most important problems of our American agriculture.

Within the past few seasons a new fence material has

come into use. Its employment, in breadth and amount, is represented by very striking figures. But these facts and figures cannot be given their due weight without some consideration of the fence question, of which they form a part. So that the topic of the present occasion, Barb Wire and the Fence Question, suggests something more than the mere statistics of wire and the assertions of manufacturers eager to extol their products.

COST OF FENCES.

Here are some of the figures of fencing derived from official sources. We have in the United States something over six million miles of fences, pretty equally distributed through all our farming regions. Taking the usual averages of cost of materials before the introduction of barb wire, the fences of the United States are held to represent an outlay of over nineteen hundred millions of dollars, about one-twelfth of our entire farm wealth, and a goodly sum upon which to fasten a saving, in future expenditure, of from one-third to one-half, if the claim of barb wire be sustained. And a figure of this magnitude goes well before this other statement, that over four hundred and fifty thousand miles of barb-wire fence have been built in the past seven seasons, for presented by itself alone this last might awaken incredulity. In 1871 the results of the inquiry instituted by the United States Board of Agriculture (*Report United States Department Agriculture, 1871*) gave $93,963,187 as the outlay for fences in the year 1869. The bulletin of the census of 1880 shows an outlay of $78,629 for building and repairing fences in 1879.

FENCES — *Cost of building and repairing, 1879.*

[Census Bulletin.]

Total United States			**$78,629,009.**
Alabama,	$1,402,609	Dakota,	$322,775
Arizona,	46,635	Delaware,	228,592
Arkansas,	1,577,144	District of Columbia,	53,041
California,	2,117,441	Florida,	366,180
Colorado,	316,603	Georgia,	1,825,625
Connecticut,	643,375	Idaho,	176,238

FENCES — Concluded.

Illinois,	$5,925,425	New Mexico,	$183,406
Indiana,	3,354,175	New York,	5,201,166
Iowa,	4,678,773	North Carolina,	1,487,460
Kansas,	2,687,056	Ohio,	4,863,063
Kentucky,	3,024,725	Oregon,	787,047
Louisiana,	1,482,121	Pennsylvania,	5,507,456
Maine,	633,069	Rhode Island,	130,555
Maryland,	1,167,760	South Carolina,	917,000
Massachusetts,	618,433	Tennessee,	2,426,543
Michigan,	2,975,644	Texas,	3,679,479
Minnesota,	1,279,527	Utah,	237,677
Mississippi,	2,557,887	Vermont,	607,962
Missouri,	4,614,416	Virginia,	1,697,180
Montana,	179,042	Washington,	300,548
Nebraska,	1,248,975	West Virginia,	952,037
Nevada,	210,721	Wisconsin,	2,620,458
New Hampshire,	334,410	Wyoming,	79,048
New Jersey,	902,807		

In his report for 1861, Secretary Flint of your own board gives the cost of the then existing fences of Massachusetts at $23,000,000, to which he adds the following estimate: The interest at six per cent. on this sum would be $1,380,-000. Add to this repairs annually, ten per cent. or $2,300,000, and the cost of renewal at the end of twenty years of one-half the fencing, we have the sum of $4,250,-000 annually for fences, or $125 on each of the 34,000 farms of this Commonwealth.

In 1862 Hon. T. C. Peters, who had for some years been engaged in the work of equalizing the landed property of that State, furnishes to the report of the New York State Agricultural Society for that year some very solid fence statistics. He gives the whole cost of the existing fences at $144,000,000, with an annual charge of twenty-eight millions to maintain them, the annual tax that the fences occasion being $1.12½ per acre, or three times the amount of the State tax.

Pennsylvania had in 1850 one hundred and twenty-eight thousand farms; the cost of fencing $150,600,000. Maine, in the same year, forty-seven thousand farms, with a cost

of twenty-five millions for fencing, the repairs calling for $2,500,000 annually. The Kentucky State Agricultural Report for 1878 declares that the one hundred and twenty-five thousand farms of that State average six hundred rods of fencing to each farm, an aggregate outlay of $75,000,000.

The Iowa Agricultural Report for 1863 contains a remarkable statement of the cost of fences, which declares that even in States where timber for fencing abounds, so much so that it is an object to get it off the land, the cost of fencing their lands exceeds the cost of the buildings required for the comfort of the inhabitants, making even more striking the computation for Iowa, where more than three-fourths of the land is entirely destitute of timber. The cost of the fences of Iowa was given in the United States Agricultural Report of 1871 at $34,729,338.

We might continue these exhibits, but enough has been presented to declare that the fence question has a meaning broadly and strongly applied to our American farming, and that any source of help to a better economy in fencing has wide application, and, if genuine, a large public benefit.

We shall not discuss the subject intelligently without some study of the system of fencing that exists, and the history of fencing upon which that system rests.

THE ENGLISH FENCE SYSTEM.

The student of the history of the English-speaking people finds the fenced field associated with the progress of civil liberty of our race through the past five hundred years. In no other European country have the incidents of the land and all the institutions connected therewith been more truly the history of a race than in England. Our English ancestry began to fence their land when their husbandry and pride in English home farming, living on the soil and by the soil, began. Good fencing was urged in Fortescue's elegant treatise on English law in 1463. It was accepted as the first axiom of husbandry in the earliest work on English agriculture by Fitzherbert in 1532, who declares, "If an acre of land be worth sixpence before it is enclosed, it will be worth eightpence when it is enclosed." (*Sir A. Fitzherbert's Book of Husbandry, 1532.*) The

Enclosure Acts by Parliament, continued through many reigns, from Henry III. even down to our own time, converted over six millions of acres of the commons to carefully enclosed fields. "Thus," says a leading writer on British rural affairs in 1816, "the commons and common fields, a disgrace to English agriculture, are being wiped away."

Some of the work of fencing done by the Parliamentary commissions under Enclosure Acts, even within this century, is worth referring to here.

In "A General View of the Agriculture of Devon," published in 1813, a fence is described as "permanently efficient for the purpose of subdivision and boundary as well as an excellent protection for stock," a statement which no one will challenge who reads how it was set up:—

> "Raising a mound on a nine feet base, with a ditch three feet wide on each side (making the whole base of the fence fifteen feet wide), facing the mound four feet high with stones, sodded three feet higher than the stone work on each side, and leaving it four feet wide on the top. Then planting the top with two rows of hawthorn."

The size of these enclosures, which seem indeed to have looked to military engineering for their defences, is stated as varying from six to eight acres.

In 1844, Hon. Henry Colman, ex-commissioner of agriculture of this State, made an extended tour in Europe with the purpose of agricultural observation and inquiry. In his published letters, in two handsome and valuable volumes, he makes some interesting notes on the features of English farming presented in the fences. He found the English field of all shapes, often not exceeding four or five acres. One farmer in Devon cultivated one hundred acres of wheat in fifty fields. In Staffordshire a sixty-five acre turnip field was in eight enclosures. Ninety-one acres in the same neighborhood were originally in twenty-seven different enclosures. Many of these farm fences occupied a strip of land four or five yards wide that the plough never touched.

It is interesting to turn over the evidences of intense fencing which cover and I must believe associated with the period of strongest growth of English home characteristics.

This pride and enjoyment of the fenced field, and the assurance of protected enjoyment which it gives, have gone with English life and living to all parts of the globe: to American States, Canadian Provinces, and the colonies of the far East.

Boundaries of land have been cared for from the most ancient times. Among many peoples the severest penalties have been set to protect the neighbor's landmark. At least one Roman emperor poured annual libations to landmarks. But the fenced field, the outworks of the Englishman's castle, his home, however humble, have had and held, through generations, a meaning dear to all of English descent. Could the Roman emperor who ordered libations to be poured to shadowy boundary lines have called from his bards such lyrics as have been written of the hedgerows of England and the rural homes they enclose? To claim too much for this would be to assert that our farmers in America are willing to pay far too roundly for a mere sentiment, and of that they will not, in their thrift, be suspected. Nevertheless, the well fenced farm stands the symbol of the well kept farm, and the sluggard's neglected acres first tell their story in his dilapidated fences.

THE FENCE IN AMERICA.

And it was in the beginning of this period of English fencing above referred to that settlements in America began. Fence laws were among the first to be entered upon the statute books of the Colonies. The fence question caused the first delegate convention ever held on this continent, in that May of 1634, when the town representatives of Boston, Charlestown, Roxbury, Watertown, Dorchester, Saugus and Salem came together to look into a certain order of the General Court, that "any man may kill any swyne that comes into his corne" (*Drake's Boston*, 154), and the town deputies held regular sessions after that, until, curiously enough, another stray hog in 1636 created what Governor Winthrop a little petulantly declares in his memoirs (Vol. 2, p. 82) "a great business on a very small occasion;" for, as one quaint writer has declared, "Mistress Sherman's pig was progenitor of the Massachusetts Senate." (*Washburn's Judicial History of Massachusetts*, p. 22.)

The principle upon which our American fence system rests has never been more strongly or better told than in an early fence law of the town of Newbury, Mass., in 1644.

"Remembering the severall inconveniencyes and multiciplicity of suits and vexations arising from the insufficiency of fences which to remedy in the old town hath been so difficult yet in our removal to the place appointed for the new town may be easily prevented. It is therefore ordered that all fences generall and particular at the first setting up shall be mayde so sufficient as to keep out all manner of swyne or other cattle great and small, and at whose fence or part of fence any swyne or other cattle shall break through, the party owning the fence shall not only beare and suffer all the damages but shall further pay for each rod so insufficient the somme of two shillings. It is likewise ordered that the owner of all such cattle as the town shall declare unruly or excessively different from all other cattle shall pay all the damages that the unruly cattle shall doe in breaking through fences." (*Town Records of Newbury, Mass.*, 1644.)

Still another law, from the town of Plymouth, twelve years earlier, shows that the fathers made an early test of the open field.

"Whereas in the beginning and first planting of the Colony it was ordered that all should plant their corn, &c., as neere as might be to the town of Plymouth aforesaid, and for that end an acre of land was allowed and allotted to each person for their own private use, and so to them and their heirs forever and whereas the said acres lay open without enclosure, divers laws and orders have been made to prevent such damage as might befal the whole by kine swine goats &c. that so by herding and other causes men's labors might be preserved and such damage or loss as fell upon any to be made good by owners of the same cattle trespassing. But since said acres are for the most part worn out, and cattle, by Gods blessing abundantly increasing, and necessity constraining to inclose elsewhere, it was thought meet at a court held the 2nd Jan. 1632 that the former privileges of said acres be laid down, and that as elsewhere no man set corn upon them without enclosure but at his peril." (*Laws of the Colony of New Plymouth*, 1632.)

At the time of the first settlements in America the common law of England required, as it still requires, every man to take care of his own cattle; but in this country, where all the lands were new and settlements sparse, it was more convenient to enclose the fields than the pastures. It was absolutely necessary that the cattle should be permitted to go at large in the forests and waste land. For

this reason, at the first, in the early American colonies, as later in Australia, the rule was adopted which has been repeated in the growth of every new State and Territory since that time, that to leave uncultivated lands open was an implied license to cattle and other stock at large to traverse and graze them. The principle of common law was inapplicable to the circumstances and condition of the people in a newly settled country, inconsistent with their habits, interests, necessities and understanding. Let us refer to some of these early fence laws, early in point of time in the history of the whole country, and early in the history of States that came or still are coming later into existence.

By early laws of Massachusetts every man was bound to fence his close not only against his neighbors, but against all the world. But of the revision by the legislature of the Commonwealth in 1785, Chief Justice Parsons says: —

"The object of the statute of 1785 was to establish the rights and obligations of tenants of adjoining occupied closes respecting the making and maintaining of partition fences, and the rights of persons not having any interest in either of the adjoining closes remain unaffected by the statutes, and are to be defined and protected by the common law." (6 Mass. 90.) Owners of cattle must keep them at home at peril.

In Connecticut, through all the revisions since 1650, the provision has existed, that whatever damage is done by cattle (unruly cattle expressly excepted), through want or insufficiency of fences, it shall not be recoverable by law. The owner and occupant of land is obliged to fence it against cattle. (21 Conn. 329.)

In Vermont the land owner owes no duty in fences except to an adjoining proprietor. Fences are to keep at home the cattle of the occupant. (38 Vt. 678.)

In Pennsylvania the common law rule, in regard to keeping one's cattle at home, is reversed by statutes, and improved lands must be fenced in order that the owner may recover for damages done by stray cattle. (25 Legal Intell. 372, 1868.)

In Ohio it has been and remains the rule to enclose

grounds for the purpose of cultivation, and to fence against animals running at large. (3 O. S. 174.)

In the State of Indiana the statute defining a lawful fence, and prohibiting the recovery of damages for cattle breaking into grounds not enclosed by such fences, applies only to outside fences; and as to inside divisions, parties in respect to trespassing animals are left to their common-law rights and liabilities. (33 Ind. 498.)

In Wisconsin only occupants of lands enclosed with fences are required by the statute to maintain partition fences between their own and adjoining lands. (19 Wis. 49.)

In Iowa the principle of common law requiring every man to keep his cattle within his own close is inapplicable to the condition of the country and the people of Iowa, and is consequently not in force. (3 Iowa, 396.)

And this rule, as stated in Iowa, has been and remains the rule in general statutes in California, and throughout the Southern and South-western States, as in North Carolina, where the owner of stock is under no obligation to restrain them to his own ground, and is not responsible for their trespass upon the lands of others not properly fenced.

In Illinois the same principle was long enforced, that the owner of land, to be able to recover for trespasses committed by the cattle of others, must enclose his lands with a lawful fence. A general law of 1845 permitted all domestic animals to run at large between the months of April and November, the same not to be taken up unless they had broken into a lawful enclosure. Changes in this law point to the advancing development of the State, and later statutes devolve the whole question of free range upon the option of local electors. The statutes requiring a legal and sufficient fence were intended to apply to all enclosures. (5 Gilman, 144.)

Flagg's review of the Agriculture of Illinois from 1683 to 1876 (Ill. Ag. Reports, 1875, p. 328) says: —

"A very important and expensive consideration in Illinois farming has been the numerous fences to exclude predatory live-stock turned into the highway by one's neighbors. The early French settlers had their common fields enclosed together, a rule that prevailed for over one hun-

dred years. For a long time what little garden or field culture was done by succeeding American settlers was fenced in. Little by little fences grew, — the law recognized them as essential to the maintenance of trespass, and the time came when communities no longer regarded the expense as a useless one."

Without further reviewing the fence policy of the different States, enough has been given to show that the conditions of their growth, and the legal system based thereon, is well epitomized in this last extract given. The fences came from necessity, grew with the growth of our farm neighborhoods, and so both by law and custom have become firmly a part of our farm system.

I think we must find the proof of the recognized universal applicability of the good and sufficient fence strongest shown in States like New York, where there has never existed a general fence law, an act of the general assembly in 1691 enabling each town within the province "to make and ordain all such rules and orders as may be needful for a better regulating their prudentials in fences." In a pretty thorough inquiry through the towns of New York I find instances of formal regulation by expressed law. But everywhere, in all the towns of New York, the rule of fencing differs in no particular from that of other States. So of Maryland, and even of Louisiana, where unwritten law, the common law of good fences, has always been the rule.

It is not because our farmers have not been told of other methods. Said a writer on rural affairs many years ago: "The reason why European modes have not been introduced into American husbandry, is because our farmers *do* understand, and not because they do not understand, what belongs to their own interests. Had systems of herding or tending beasts at pasture, of soiling and enclosing pastures by portable fences, been profitable, they would have been adopted years ago by practical farmers. Both the herding and the hurdle systems have objections no practical farmer will be likely to seek to overcome, from expense of attendants in the one case, and cost of original construction, waste, breakage, and expense of removal, in the other. The best farm authorities have declared that the system of soiling is only a certain mode of purchasing dung, and this becomes

increasingly costly from the distance from the fields where the green crops grow.

To show how little attractive our American farmers would find the much praised French farm system, Dr. Loring, in his admirable paper on the *Problem of American Land-holding*, deserves to be quoted here.

"It is true that the French farmers are citizens of a republic, and are owners of the soil on which they live; but it is a republic without the traditions of freedom; a soil divided among them by violence before they had reached the point of citizenship — there the home of the American farmer is not found.

"The American farmhouse is almost unknown. The peasantry gather for the night into crowded towns far away from their lands and go forth by day to till their few outlying acres."

Still another writer says of these French farmers: —

"It is an error to ascribe the thrift of the French people to the subdivision of their land. We shall find it arises from *their habit of going without themselves*. The ability of the French peasants to live on a cheap and limited fare is proverbial. They are by necessity cut off from the means of acquiring knowledge, are subjected to incessant toil, and a degraded social life."

THE "NO-FENCE" LAWS.

But it will be asked, is not the no-fence principle being tried on an extended scale in some of our States? What of the Herd Law in Kansas, and the no-fence systems, so called, of Virginia, North Carolina and other Southern States? The reply, in brief, is that in neither of these systems is there an attempt to do without fences. The Kansas Herd Law of 1872 was designed to meet the pressing facts of vast herds feeding at large on open ranges among scattered farms of new and in most cases poor farmers, with all fence material scarce, and a need of protection which fences alone could give under the general law. The General Fence Law of Kansas still remains in force, but the several counties have the option to set it aside within their own limits, and declare common law in force within the same. It is recognized by the citizens themselves as a conflict between herd-raisers and planters. Forty-one counties have adopted the Herd Law. Thirty counties remain under the General Fence Law. But who can fail to see that the Kansas Herd Law makes neces-

sary the strict fencing of cattle, and only makes more strict pasture enclosures where free range is abolished?

In Virginia and other States where the "no-fence" system, so called, exists, and has extended to other States, any and all townships and counties, or parts of the same, have the option to do away with the General Fence Law, but only by establishing and maintaining on their outer boundary a legal fence, with gates at all highways. This is therefore not a doing away with fences, for, besides these outer fences in common, all beasts kept within the territory enclosed must be strictly fenced in by their owners.

Said a writer in the "Rural New Yorker," 1856, reviewing the no-fence theory, as described by admiring letter-writers from Europe, and its advocates in this country: —

> "No system of management could be adopted in which fences could be dispensed with without a loss or outlay in some other channel amounting to more than the annual estimated average cost per acre for the maintenance of fences. He utters what is the American farm verdict: 'We cannot get along without fences as a necessary evil, if such they are.'"

THE HERD LAWS.

With their advance from the conditions of first settlement, our American communities have increased the stringency of herd laws. But this, through generations past, has pointed to stricter fencing where fencing is required.

Let us seek within reasonable limits some answer to the inquiry,

WHY DO WE FENCE?

Evidently the rule of common law will not do away with fences, for England is the home of the common law, yet she is to-day the closest fenced country in the world.

Mixed husbandry, arable and pasture, for crops and herds, on the same farm, large or small, will always make fences necessary. Much will be saved by larger fields. Small fields can be thrown together to the great saving of fences and the soil they hold out of use. In most of the States, roadside fences can be done away with if the farmer's peace of mind permits it; but this only because he and his neighbors take good care of the fences that restrain their beasts. The general law of estrays is essentially the same

in all the older States; but the provision is even more universal, that to entitle the land-owner to damages he must be shown to have maintained a legal fence, the height of which varies from four to four and a half feet in the Northern States, and five feet in the States of the South and Southwest, wood being the almost universal material, and the worm fence so commonly employed as to have been termed the national fence.

We fence by law, by custom, and by a recognized necessity.

But let us now review some of

THE FENCE EVILS.

These come from original cost of material and construction, and from features inherent in fences of the old construction. If you had the patience to turn with me the farm journals and farm reports since the first years of this century, you would be astonished at the bulk and frequency of complaints at these features of the fence burden. The first settlers east of the Alleghanies found wood and stone plenty. It was with them only a question of labor. So it was in the deep clearings of the first settlements in the valley of the Mississippi. But in the new prairie regions, where there was no timber for fencing, and in the older States, where waste of timber began to tell, the cry was heard in farm discussions years ago, "What shall we do for fences? We must have some other material." The consumption of wood in fences built of rails is strikingly shown in the Kentucky State Agricultural Report for 1878, before referred to, as follows:—

"For the 75 million rods, chiefly of the old worm fence, have been required 2,000 millions of rails, and not less than 70 million rail-trees. To keep this fencing in repair will demand a yearly consumption of 280 million rails, and the destruction of ten millions of timber trees."

THE HEDGE IN AMERICA.

The hedge was given a liberal trial early in this century, and through many years following. It was continued through more than one generation of our farmers. It was liberally and expensively tried. It failed. The indictment

against the hedge was, that it is costly to create and maintain, treacherous and troublesome always. It engrosses much soil by occupancy and shade. It furnishes coverts and lurking places for all manner of pests of the crop. It is stunted and worthless as a barrier in one place, is hugely overgrown in others. English agricultural authorities of repute have claimed that in some of the best farm districts of England the hedges engross one-fifth of the soil. One leading writer declares the loss of one million two hundred acres by the hedgerows that enclose English fields. Prof. Roberts of Cornell University, in a series of letters to the "Rural New Yorker" on the "Lights and Shadows of English Farming," says: "To see a double line of half-dead, unkempt thorn trees, enclosing often less than three acres, makes one exclaim, 'Why cumbereth it the ground?'" Several years ago premiums were offered in England for the eradication of these old hedges.

The Ohio State Agricultural Convention at Columbus, in 1877, discussed this subject fully. It was stated by one speaker that some of the hedges in Champaign County were forty feet high, and that you could not get a horse within ten feet of the fence. He had a neighbor who was willing to pay five hundred dollars to get rid of his hedges.

Is it not about time to get rid of the hedge schoolmasters in our agriculture, for this is the verdict of the last half-century against the hedge, both in America and in England.

In Illinois and other prairie States, the hedge has been carefully and expensively tested for a farm fence, and it has passed well-nigh out of discussion.

But the old fences had, and still perpetuate, other evils, whose telling fills many pages of agricultural reports and authorities of repute.

Secretary Flint's report of 1861, before referred to, says, in strong language: —

"The fence waste is not merely in the cost of fences and repairing. A very large item is the land occupied by the fence, and worthless because uncultivated on each side. A large part of our fence is Virginia fence, which will measure through the bottom three feet. Bush siding and staked fences take as much. We think, therefore, that four feet is a moderate estimate for the land under and on both sides of our fences,

which is uncultivated and worse than useless. This would leave on both sides of the fence enclosing ten acres, one and one-fourth acres; on the twenty-three million rods of fencing in the State, thirty-one thousand two hundred and fifty acres of land unoccupied, untilled, a refuge for almost every kind of vermin that walks, flies, or crawls." *(Report Massachusetts State Board of Agriculture, 1861.)*

The "Annual Register of Rural Affairs" (Albany), in 1860, said that the entire loss to the ten million arable acres of the State of New York from the zigzag form of fences, was not less than three hundred thousand acres, or three thousand good farms. The same complaint had been made many years before. I find in the "American Farmer" (Baltimore), in 1828, a ringing protest against the fence waste.

The "American Agriculturist" declared, in 1867, that a farm of one hundred and sixty acres, as fenced on many old farms, has twenty acres of land taken up in this worse than useless manner.

The notes from a farm in Sutton, Mass. (*Massachusetts Agricultural Reports, 1854*), show twenty-four acres enclosed in eight different lots, the stone walls actually covering two acres, or one-twelfth of the tract.

These are certainly good reasons for

FENCE REFORM,

And this must be sought in a diminished employment of fences; by securing more perfect fences where enclosures are needed. We cannot have the open cropped field secure unless the beasts are safe in pasture. Wood, as fence material, is wasteful, because perishable, and is becoming each year more costly. Competent authorities in the lumber trade estimate that in twelve years the whole supply of pine lumber east of the Mississippi will have become exhausted. Stone fences are inadmissible where not absolutely needed as a measure for clearing the rocky field.

The fence must be lighter in construction to save waste of soil in occupancy and shade. It must be an available material widely applicable.

WIRE FENCING.

Sixty-seven years ago these demands distinctly pointed to iron wire. The memoirs of the Philadelphia Agricultural Society for 1816 contain careful computations of the value of iron wire as fence material, asserting: "We have given it a fair trial at the Falls of Schuylkill with the most breachy cows of the neighborhood, and it is remarkable that even dogs avoid passing over it." In 1821 the "American Farmer" of Baltimore urged the same use for wire. In 1830, the "Journal of the Franklin Institute" (Philadelphia), referring to a patent for a wire fence, declared them no novelty, but in approved and successful use. From that time forward references to the utility of wire fencing became common in farm journals and reports. The New York Agricultural Society in 1847 awarded their silver medal for wire fence as cheaper and more effective for farm use than wood. In 1849 the "Plough, Loom and Anvil" of Philadelphia uttered this wise and far-seeing opinion, which covers the essential fact of wire as fence material: "Setting aside merits, the demand for wood fences will increase the price, while the demand for wire fences will decrease the price, as the greater the demand for wire the cheaper it can be made." Wire was urged for fence material while it was yet in this country a costly material, hand-drawn by a workman whose stint was from forty to forty-five pounds per day. It was not until after 1830 that machine drawing was introduced, a single machine now producing fifteen hundred pounds of wire daily.

Within the period of twenty years between 1850 and 1870 it is estimated that three hundred and fifty thousand miles of plain iron wire passed into use in fencing. But plain wire was never a full success. It sagged in heat, and snapped in cold, and had no terrors for cattle, who broke through it in all directions.

In 1874 an Illinois farmer, studying his own needs, armed his plain fence with a sharply pricking barb, intended and successful as an appeal to the quick warning sense of pain residing in the skin of the animals who possess most acute instincts in guarding it. The history of

barb wire fencing since that time is told in the following emphatic figures : —

	Miles.
1874,	10
1875,	600
1876,	2,840
1877,	12,863
1878,	26,655
1879,	50,337
1880,	80,500
1881,	120,000
1882,	160,000

Or a total to the present time of 453,805 miles.

No invention of sterling value stands simple and alone, perfect from the beginning. Nearly two hundred and fifty patents exist pertaining to barb wire and its manufacture. Ingenuity and patience are still at work perfecting the product. I illustrate, in this connection, a few of the most common forms of barb wire brought out previous to 1882. Others have been added since. It is enough here to say of the commodity, that the search is for simplicity, cheapness and effectiveness. For the latter the sharply pricking barb must and will be retained; but it should not be needlessly barbarous. It is found that the views of farmers and stock-raisers differ, but the tendency is to a short, firm barb, which, however, cannot carry too keen a point.

It is the essential principle of barb wire to instantly warn the infringing animal. If it does less than this he may find the mildly scratching substitute grateful to his itching skin, and thus assaults may be invited no fence structure can withstand. The animal must be satisfied with one contact with barb wire, and let it alone thereafter. Nothing less than this will accomplish the purposes barb wire is set to serve. Nor should the barb be a keen hook to tear the skin. That form is best which, standing at right angles to the line wire, does not, in the well-constructed fence, wound beyond the first prick. All farm stock soon learn where the barb fence line is, and the breachy and most venturesome heed it soonest because earliest taught.

In its construction the fabric should be firmly made, to be durable; and, happily, the modern use of Bessemer steel,

replacing the common uses of iron wire, gives a material of great lightness and strength. The doubled and twisted wire removes the former evils arising from changing temperatures upon the fence; but the twist should be evenly laid to give the strand the full strength of both wires. An excellent material is furnished in flattened or strip wire, giving, where desired, a more visible fence; but the most universal form of barb fencing is presented in two twisted galvanized steel wires, upon which the barb is inwrought. So familiar is the article among the supplies of the agricultural depots and in fence use that no further description here is necessary. Its merits may be briefly told.

1. It makes a strong effective fence.

2. It is easily handled, shipped in rolls containing eighty rods of fencing; two of these have about the same weight and bulk as a barrel of flour. The farm team can haul from the railway station to any part of the farm enough material for two or three miles of fence. The railway freight car will carry over twenty miles of fence material in one load. Compare this with the nineteen times greater bulk of wood fencing, whether rails, boards or poles.

3. It everywhere compares, in the cost of wood fences, even through timbered land, with a saving of from one-third to one-half.

4. It is easily and quickly erected by such skill and tools as the farm can readily command. It will make an effective barrier with one, two, three, four or five strands, varying with the farmer's needs. In the first form, of a single strand attached to trees through woodlands, it is to-day furnishing thousands of miles of effective barrier to large stock on hill pastures in New England, where a more efficient and costly fence is not believed to be warranted. Said one large farmer in Vermont who fences in this manner, "I am getting a return on twenty-four hundred dollars from land that has been worthless to me, and would not pay for solid fencing."

5. It is imperishable by fire. One hundred thousand miles of barb fencing are in use on our railroad lines, which are required to be carefully fenced in all the States, either by express statute, or by the interest of the railway com-

panies. Along these lines the neglected summer vegetation furnishes quick fuel after the frost has killed it down. The farmers' brush and rail fences are in constant peril of destruction from the same cause. Barb-wire fences stand securely against the quick, short burning of the dry herbage which only chars the posts. Barb fence cannot be burned down, or destroyed by wind or flood.

6. In snow regions barb fencing accumulates no snow-drifts in roadways or on the field borders. The former are a cost to the public; the latter a large source of detention and loss in spring work to the farmers. In numerous towns in New England the local authorities, recognizing this merit of barb wire, are supplying the article to farmers where the exposure of the roadway causes drifts in winter, that they may replace the wood fences by long custom removed at such places in the snow periods.

7. It occupies only a strip of soil, and shades none. It gives no shelter to pests of the crop, vegetable, animal or insect.

8. These are some of the already familiar reasons why barb fencing has come into its present place of prominence in our farming. To amplify these would be needless here.

BARB WIRE IN USE.

But there are certain important historical facts and aspects that belong to the introduction of barb fencing that deserve to be considered here. To this our age nobly belongs a care for dumb beasts, from which has resulted organizations which have special heed to cruelty to animals. The sharp fence barb was instantly challenged as a cruel resort. It shows the exceeding stress of the fence need that barb fencing went forward under such a challenge to the breadth of adoption it has gained in seven years. It has not been left without formal inquiry in the State legislatures. Investigations by legislative committees in Massachusetts, New Hampshire, Vermont, Connecticut, Ohio, Michigan, and other States have been carefully made within the past three years, and this after barb fencing had come into such extensive use that the testimony of the best and most experienced farmers could be called out. Such testimony has in every instance

declared that the accidents from the barb are not relatively numerous, are mainly trivial, or where more serious do not swell the number of accidents that have always occurred from fences.

In no State in the Union has any law been secured, prohibitory or restrictive. In Iowa, Minnesota, Wisconsin, Texas, and Washington Territory, barb-fence legislation has prescribed the number of strands and barbs, to check a too light construction of a material easily made into a repellant fence barrier.

But even this form of legislation has been rejected, though sought in other States, the farmers' uses so varying that they desire to employ the material in their own fashion. And there seems to be no general peril in this, since the suitableness and due legal character of any fence is devolved, in all the States, upon local authorities, either fence viewers or town and county officers, from whom, or through the courts, can be secured a legal check everywhere against insufficient fencing of whatever kind.

This is true of the whole subject of the alleged cruelty of barb wire. It is least dreaded wherever barb wire is in most common use. It is most a matter of complaint and protest in regions where it is least known, and by those who have no direct interest whatever in farm fences.

Do not accidents occur from barb wire? It is undeniable; but fence accidents are no novelty. The chief subjects of such accidents are lively horses, and these are always in more or less peril from common fences. The special perils of barb wire to this class of farm stock, many farmers who use barb wire are themselves guarding against, by making their fences more visible, at least until such stock get accustomed to them. A light wooden strip in place of the second wire from the top, or some sightly, cheap attachment to the top wire,— wood, metal, or, as in one case I have seen, bits ot cloth, — will warn and educate the animals to heed the fence and will be perfectly effective. So, too, may be said to be the even more common practice of leading the horse to the fence line, and showing him that barbs will prick. Careful inquiries in Niagara County, New York, as well as localities in Vermont where horse-breeding is a farm specialty, have furnished the basis from which these statements are drawn.

Barb wire has had its careful trial by newspapers, whose columns have been open, and in signal instances have invited complaints against it. But its most signal defence seems to me to come negatively from the diligence with which the societies for prevention of cruelty to animals, and their national organization, the American Humane Association, have followed the inquiry into this subject, for the past two or three years. They have not found in it an occasion for the action the public has the right to expect from them, did genuine grounds for such action exist; on the contrary, they have openly refused appeals for such action. Certain very broad and striking facts, both in the oldest and the newest States and Territories, have followed the introduction of barb wire. Many thousand acres of cheap and poor land, not believed worth substantial fencing after the old style, are being fenced in New England, increasing the area of available pasturage. Not a few farmers are resorting to its use to cheaply protect their wood lots, holding it not a good principle to feed their beasts on tender saplings that may be worth protecting.

In the South, under its new system of divided farm lands, such writers as Edward Atkinson are pointing to the utility of barb wire as cheap and available in protecting the crops of the new and small farmers, helping the raising of cotton and the breeding of sheep; and sheep-breeders, everywhere, are beginning to study how the barb may antidote the sheep-killing dog and bring back sheep-raising to regions whence the mutton-loving canines long ago banished or impoverished it.

Barb wire is rapidly doing away with the system of free ranges in the great open regions of the South-west and the interior, and on the Pacific slope, where, not long ago, fencing was not dreamed of as possible. The owner of thousands of acres of grazing land fences his possessions with barb wire. In New Mexico a pasture of seven hundred thousand acres is enclosed with barb wire. In Nueces County, Texas, there are eighty thousand acres in one vast pasture. In the Ozark region of Missouri thirty thousand acres are being similarly enclosed for a sheep farm. Lines of barb fencing from ten to twenty miles in length are not

unusual in regions where, not long ago, to embark in the cattle business it was only necessary to buy the cattle. All this is changed; the herdsman must become a land-owner, and the land-owner can control his own herds, now that he can fence his broad acres cheaply and effectively. I leave it for those versed in the facts of the cattle trade to give full weight to the advantage of parting with free range and its perils of loose infectious herds, for a system that makes cattle-raising as close and easily controlled as on a New England farm.

I have thus sought to sketch, as briefly as possible, the facts on which the utility of a new fence material rests, and I have the belief that it cannot be intelligently considered with any less ample range of view than that which should take in the whole subject of fences.

Mr. Ware. I suppose all persons, and farmers particularly, are desirous of obtaining facts, and learning the experience of those who have tried barbed wire fence. I have had some experience that may be of interest. I put up about six rods of barbed wire fence of the most approved kind. I had had a very high opinion of it. I turned a horse out for a little exercise. He was a horse that was particularly desirous of showing off his good points. After he had been out a sufficient length of time, I called him to the barn. I had always noticed that this horse did not care to exhibit himself unless he had spectators. When I called him, he took another turn around the field, head and tail erect, looking for all the world a horse. He ran in the direction of my barbed fence. I felt that the fence was in some danger. He approached it and struck it, and he was held there. In struggling to get away, that barbed fence sawed into his flesh across the arm and shoulder to such a depth that, when he got away, it was perfectly frightful. I got him to the barn, and querie l at first whether I should knock him in the head at once, or try to save him. I wanted to save him, and I sent for a veterinary surgeon to examine him. He trimmed the ghastly wound by cutting off the ragged edges, and I nursed that horse for three or four months carefully, and finally he was cured. He is now a serviceable horse.

The next year, a pair of valuable carriage horses that were stabled with me were turned out for exercise. One of them took a turn around in this same direction, and caught in the fence in the same way, and in the same place, and, in struggling to get away, the barbed fence sawed into his shoulder worse than in the other case. The veterinary surgeon was sent for, and, after examining the horse, he said that he could not be saved, and the horse was knocked in the head. That was my experience in two years with six rods of barbed fence, which I thought was sufficient for me. I have taken down the fence, and substituted something else.

I do not say that this may not be a desirable style of fencing on the broad prairies, or where extensive tracts are to be enclosed; but it does seem to me that it is unsafe for us in Massachusetts, where we have small enclosures, and where cattle and horses are liable to come in contact with it; and, if these facts that I have named had been brought to the attention of the society for the prevention of cruelty to animals, it seems to me there would have been some action taken before this time in regard to this matter. I have never spoken of this in public before; I have spoken of it to my friends frequently; but it seemed to me that this was the occasion where it should be mentioned. I believe the gentleman courts the experience of farmers, and the certificates of farmers, as to the merits of the wire fence, and therefore I add this, my certificate, to the merits of barbed wire fence.

Mr. Hillman. I want to give an account of three years' experience in the use of barbed wire. I think a gentleman who has lived as long as brother Ware has, and who is as intelligent as he is, should have known better than to allow a horse that he kept in the stable to be turned out loose, and run at large in a field that was fenced with barbed wire, with which the horse had no acquaintance.

Three years ago I wanted to get a driveway from my barn to my pasture, in order to get my cows conveniently across a meadow. I had a great deal of work to do, and very little time for making fence. I bought barbed wire, took a few old posts and stakes that I had, put them in about three or four rods apart, and strung the wire across. That answered

every purpose; and during the whole summer I never saw a cow attempt to reach through the fence. I ran two wires along. The cows would go up to the fence, and feel of it by putting their noses against it, and that was all the acquaintance with the barbed wire that they cared to have, and after that they would go on their way.

The next season I removed a wall from the front of my house to the opposite side of the road, where there was a row of elm trees, and I extended two wires along and attached them to those elm trees. After awhile, I wanted to drive my cows through where there was no barbed wire. They went through for a time, and formed a path where they had been in the habit of going night and morning. A little later, I wished to close up that avenue, and also to put up a gate, so that the neighbors' cattle, in case they came on to the highway, should not get into my field. I closed that gap across where the cows had been in the habit of going night and morning. At night, when they were driven up, I had the curiosity to see what they would do with the fence, expecting those cows would come down and come in contact with it. Instead of that, they came out into the road, passed along to the gateway, and did not attempt to go near that wire fence. Having made its acquaintance formerly, they recognized the character of that wire which I had put across the path they had been accustomed to travel, at a distance of a rod and a half.

This last autumn I wished to cut off a part of an orchard where I had some land which I did not wish to have my cows walk over. They had got in there before, and got a taste of some of the apples in that part of the orchard. I got some wire and fastened two strands of it to the apple trees, that were thirty-three feet apart, with a single staple; and in the morning, when the cows were turned out, they went at once down into the field, and walked the whole length of the wire fence, and then turned and walked back in procession, some twenty or thirty head of them, and then went about their business.

There was a piece of old rail fence against a cornfield, with some young stock and a bull in the field adjoining, and the bull found out that there was corn in that field, so he

took up a length of the fence, and took the heifers along with him into the cornfield. I put up the fence and shut up the bull, but the heifers had learned how to do it, and I had to build a new fence. So I got some barbed wire, and put a single strand along that fence between the upper rail and the next one. The heifers walked the whole length of the fence; they didn't like the looks of it, and went and jumped over into the road, supposing that that would bring them into the cornfield. I put them back again, and put in a few stakes where there was a low place where the bull went over, along by the wall, and put a string of wire there; and I had no more trouble with that field. In other instances, where I had a worn-out rail fence that ought to have been removed, and a new fence put in the place of it, I have found that, by stringing a single wire, I could make the fence perfectly safe. I say this because, as far as my experience goes, which extends now over three years, this barbed fence wire has proved perfectly safe, and more economical than any other kind of fence that I can conceive of.

Mr. Ware. It seems to me that where horses are never to be turned out, nor cattle, this wire fence may be very suitable. I have related my experience where horses were turned out, but where horses and cattle are not turned out it is an excellent fence.

Mr. Stoddard of East Brookfield. I have had experience during the last four years in the use of wire fence. I have used it under a great many different conditions, and I have never had any trouble or damage caused to any of my cattle or horses by it. When I first let a horse into a field fenced with a wire fence, if he is not used to that kind of fence I lead him up and touch his nose to it, and he finds there is something there that is not intended for him to run against. If you try to run a horse up there, you cannot get him within a rod or two after he has had a little experience with it. The same thing will apply to cattle. I have found that, by building a fence with perhaps three wires, I could keep bulls in a field that no other fence would keep within bounds. In one instance I put up two rails and one wire, and that would keep my bull, or any other bull that I ever saw, in that pasture. Any other fence, unless it was an extra good one, he

would jump or break through. I have put up nearly two hundred rods of this wire fence during the last four years, and I have never had the least trouble with it. I have always found that it keeps the cattle where they belong.

QUESTION. What is the expense per rod?

Mr. STODDARD. I think it is ten or eleven cents a pound, fourteen and one-half feet long. If you put up three strands, it will cost you about thirty-three cents a rod for the wire.

Mr. CHOATE of South Hadley. I put a barbed wire fence around a cornfield next to my pasture, a year ago this last summer, and not long after the fence had been built I turned out a horse that had been worked for two months every day. The horse came up to the fence and got cut up in the way Mr. Ware has described, only it was cut in the chest. You could put your fist in the wound; the horse died in a month. That is my experience with barbed wire so far as horses are concerned. But for cattle, there is nothing in the world equal to it. As one gentleman said, a single wire on an old, dilapidated fence will turn any cow, even if the cow has got into a cornfield; and every farmer knows how difficult it is to keep cows in a dried-up pasture after they have once broken into a fresh cornfield. But one wire, if not more than three feet high, will be a sure protection against them. Three wires will make a fence, if you set the poles sufficiently thick, say one rod apart, that will turn any stock in the world, except horses; and I think the remedy for any difficulty in regard to horses would be to put a board either on the top wire or the middle one. I was to blame, as the gentleman (Mr. Ware) was, for turning my horse into the pasture without taking him up to the fence, that he might see what there was there. The horse, feeling well, would run against the fence before he was aware that there was any fence there; that was the trouble.

Mr. RUSSELL. I have kept a good many horses for years, and I have had the same difficulties that Mr. Ware has described, from horses being injured against stone walls. I will give my experience of one summer with a stone wall. I had four acres in which I kept some breeding mares, and a number of mares together are sometimes quarrelsome. One

of those mares was cut so badly that we were two or three months nursing her. Another one, a two-year-old filly that I never turned out for more than a day, got blemishes that to-day are eyesores to me, and prevented me from selling a valuable horse. That was a rough stone wall, such as we find everywhere.

In regard to pasturing horses, it is rather doubtful whether it is good policy to pasture horses at all. You can pasture colts, and you can teach colts at a very early age the danger of a barbed fence. The trouble with horses is, that they do not see, when they are careering wildly about the paddock, what is before them; they cross it, and when they come to the fence they run into it. If you will put a light rail on top of the wire, a horse will be no more likely to run against it than he is to run against a rough board fence. I have seen my colts careering at full speed until they came to a board fence, and then they would spring back and make a sharp turn; if they struck the board fence they would take off skin, and be badly blemished. They might strike a board fence in a way that would be almost fatal to them. Horses have been very badly hurt, when they have been chasing one another, against the sharp edges of a board fence. It is very easy to teach a horse the danger there is in touching a barbed wire; they learn it very readily. The lightest piece of rail put on top of the wire, that will attract a horse's attention, will prevent him from striking the wire. I regard the barbed wire fences that I have put up on my own place, as very great economy. I had a cow that I could not keep quiet, she would tear down any board fence. I wanted to keep her and I put up a barbed fence. The first day she went out with the determination to clear away the fence as usual, and touched her nose to it once or twice with that intention. The result was, that I noticed she spent an hour or two in rubbing her nose in the dirt, and since that time she has not meddled with the fence at all.

Mr. Hillman. In driving past the farm buildings of Mr. Bowditch, I think I noticed a small enclosure surrounded with barbed wire, with a strip of board upon it. If he is here, will he give us his experience?

Mr. Bowditch. You are perfectly correct, Mr. Hillman.

I have never thought it advisable to use barbed wire in any field where I turn out horses. I have never cared to do it, because I take a great many horses to board, and if I turn them out at all, I want to turn them out where they will receive no harm. Therefore, I have never used any barbed wire where I expected to turn out horses, without putting a light rail upon it. The fence of which Mr. Hillman speaks has a very light board upon it, hardly three-quarters of an inch broad. I have used the field to turn out calves at twenty-four hours old, with their dams, to exercise. I have never seen a calf receive a scratch from it. The first piece I put up was around a field where I keep my young dairy stock. My dairy cows pass it every day, and I have never known my cattle to receive a scratch from it in the three or four years I have used it. I tried the ribbon wire, thinking it would make a fence which horses would see without the top rail. I put up quite a long strip, without any barbs on it. It is very true that the animals saw it, but they liked to rub against it, and they rubbed through it, so I had to put a strand of barbed wire on top, on the inside. I think the ribbon wire would be a perfectly safe fence to put around a field where horses are to be turned out, if they were turned out in daylight, when they could see it. I don't think any horse would try it after he had seen it.

QUESTION. I would like to know what the gentleman means by ribbon wire?

Mr. BOWDITCH. Mr Smith can describe it better than I.

Mr. SMITH. It is just about as wide as narrow tape. It is half an inch wide. It is simply flattened wire.

Mr. ——— There is a very fine fence of that description in my neighborhood, that is very easily discernible by horses or by cattle. I have some of that wire in my barn ready to put up in the spring. It is nearly half an inch wide. It is twisted when it is put up so that it shows very plainly.

Mr. SMITH. I think the wire to which the gentleman refers is called the Brinckerhoff wire. It costs the same as the other wire.

Mr. BOWDITCH. I found that this wire without barbs offered almost no resistance. My yearling calves would go through it. It broke very easily. I recollect a friend of

mine told me a story with regard to the ease with which his cattle went through one of the early kinds of wire fence. He said it disappeared. He did not know the fence was there. I think very likely. A large animal scratching against that wire would cause it to give way.

QUESTION. Does it not break where it is stapled?

Mr. BOWDITCH. If you drive the staples too hard. But it has broken with me directly between the staples. I don't think the barb-wire fence is good for sheep, for the reason that they will pull their wool off by rubbing against it. Perhaps the barbs will not go through and strike the skin any more than to produce a pleasant irritation, which they like, and the consequence will be, you will find your fences lined with little tufts of wool.

Mr. SEDGWICK. I have a sheep pasture fenced with barbed wire, and it answers an admirable purpose. Not only that, but the fence is on the roadside, and at times the sheep have been troubled by dogs; but since that wire fence has been there, there has been no trouble at all from that source. I have noticed one trouble, and that is, that where the wire lies under snow-drifts, it almost invariably snaps off in the spring. I don't know but it may be that the wire is drawn a little too tight. It is the four-pointed wire, galvanized. In this connection let me say that I have had a pasture this summer where I kept three horses; there are sixty rods of wire fence on one side of the pasture, and I have never had any stock of any kind injured by it. I have used over fifty-two hundred pounds of the barbed wire for fences the last year. Another thing: it is one of the best things to use on an old stone wall. If you have an old wall that needs building over, and you have not the time to do it, just set up a few stakes, and put up one or two strands of wire, and you have got one of the best fences that can be made. One of the things that I like about it very much is that it won't winter-kill, and it don't burn up.

Mr. H. M. SESSIONS of Atlanta, Ga. I have been where there is no other fence but wire fence. The lecturer referred to the fact that wire fences were necessary at the West on account of the prairie fires. We have wire fences down in Georgia to protect against *cabin* fires. If a wooden

fence is built, the people will very soon burn it up in their cabins, but a wire fence they cannot burn up. And we find it very convenient to catch the thieves that we have there who "grabble" potatoes, and steal our corn and strawberries. But a wire fence is the only fence that can be used in Georgia to stop the cattle that run on the commons; they will jump over or tear away everything else.

Mr. Hillman. I have used willow stakes with great satisfaction. Those will grow and give you living posts. If there is any danger of making a tree, all you have got to do is to saw off the top. In case of fire, it will not burn, because it is green, and when you have got your wires upon these stakes, you have got a perfectly safe fence. It is especially desirable, if you are building against a wood-lot. There is more trouble with neighbors about building fences against wood-lots than almost anything else, because the person on the other side thinks he ought not to build half of the fence. If you have a wire fence, you can take up your fence along with the trees. It is the cheapest fence that can be put up.

Mr. Waterman. I have had no experience in this matter, but I can state how they make wire fences in Williamstown, where I live. They put two rows together, with a five-inch spruce board at the top. No horse could get over that.

Mr. Russell. I do not regard ribbon wire as of any value; in my experience it breaks very frequently. I used it to keep my sheep in, but they crawled through it as if there had been nothing there. I don't think it is of value for the purpose of keeping stock in a field; it is too brittle. It breaks with me very often. I am ready to take mine off, and put a strand of wire, without barbs, on the lower part of the fence.

Mr. Hillman. If Mr. Smith is able to do so, I wish he would inform us whether it is advisable to use iron posts, how much it would cost, and so on.

Mr. Smith. Sometimes, when a clergyman (I am the son of a clergyman) loses his pulpit, he goes into some other business; and the other day a clergyman came to me at Worcester, and said that he had invented a new fence post;

he felt sure that he had got an idea in regard to fence posts that was just what was wanted. I introduced him to one of the proprietors of a large mill there, and said to him, "If you will take that book, and sit down and look it over, you will find out whether you have really invented a fence post or not." In half an hour he came to me, one of the most discouraged men I have ever seen, and said, "Every point I have got is in that book thirty or forty times." There is not one pattern, of some three or four hundred of those posts, which is regarded as a perfect success as an iron post. If you have a post heavy enough to stand erect, it involves great weight of iron; if you have a light one, you will get deceived with regard to the durability of the post.

I want to make one suggestion, and that is, whether, in the case of a leaping animal, the top of the fence should not always be of barbed wire; otherwise you invite the horse or other animal to leap, or there is danger of his leaping.

Mr. Hersey. I think that the barbed-wire fence will be adopted generally throughout the country, on account of its economy. I think it will be a great help to the farmers of Massachusetts whose fences are now rapidly running down. I form this opinion from observation and from experience. A neighbor of mine, who has had a great deal of trouble in keeping his fences up during the past twenty-five years, has, during the past six years, put up probably two miles of wire fence; but a considerable portion of that fence is only one strand, which he nails to the posts of his old fence. Where he sets new posts, he puts them twenty-five feet apart, and puts on only two wires. But with this fence he has succeeded in keeping his cattle in his pasture. I believe they have never gone through it. If we can do this, you can see at once how great is the economy. The wire will cost only about twenty-two cents a rod where you put it for a permanent fence, exclusive of the expense of the posts. In some portions of the State, the posts are not very expensive, but if you can put your posts twenty-five feet apart, the expense is not going to be very great anywhere. I was so satisfied from observation of my neighbor and his success, that I have myself, during the past year, put up

more than half a mile, probably; but where I have made a permanent fence, I have used four wires, for the purpose of keeping dogs out of my sheep-pasture; but where I put only cows, I have used but two wires.

Something has been said about fencing woodland. I have had some experience in that respect. I ran two wires on one side of a pasture which I owned next to some which was owned by other parties, who of course would not fence. I have run two wires the whole length of that part of my pasture and have thus saved the posts, and have been to the expense of only twenty-two cents a rod. When you once get this wire up, it is a permanent thing; it rarely breaks unless you draw it too tight. I think you may make it too tight, so that it will break in very cold weather; but I see no reason why it will not last for many years, where it is nailed to trees that are alive.

In regard to the danger to cattle. I do not apprehend that we shall have much trouble in regard to that. We may have some trouble, as we do with picket fence. It is but a few days ago that a friend of mine had a very valuable horse killed by going onto a picket fence. I have known many horses that were killed in that way, and yet we do not abandon the picket fences. I do not like them; I do not think they make very good fences; and yet I have never heard of any one abandoning them because horses get killed on them. I do not know of a single instance, in three or four years' observation which I have had, where an animal has been injured by the barbed wire.

In regard to the ribbon wire, so far as my observation goes, that is very apt tò break. There does not seem to be that "give" to it that there is to the twisted round wire, and I should very much doubt whether it would be advisable for farmers to use it at all. But the barbed wire, I think, is something that we are going to use.

The Chairman. I want to ask Mr. Smith one question. Do you know the comparative amount of metal in a strip of ribbon wire half an inch wide, and the amount of metal in a double-twisted wire?

Mr. Smith. The weight is about the same, and the ordinary price is the same. I think the ribbon wire is a little

lighter than the two wires, but the amount of metal is not largely different, as shown by the price.

The CHAIRMAN. One would think by looking at it, that there was much less metal in the ribbon wire than in the two twisted wires.

Mr. SMITH. I think where the barbs are put on the ribbon wire, it weighs a little more, but the plain wire weighs a little less than the barbed wire.

Mr. SHEPARD. It has been stated by a number of persons here, that they have never known of horned cattle being injured by the barbed wire. I have some barbed-wire fence, and I had one cow injured by it. She had recently calved, and was put in the pasture, and wanted to get home to her calf. She jumped the barbed fence and tore her bag pretty badly. She was turned into the same field the next day, but she never attempted to jump the fence a second time. I have had strange cows put into my droves, and I have had them go through a barbed-wire fence where I had four wires, but they kept away from it after they had been through it once. I have seen calves go under the fence a number of times, when they did not get their backs scratched at all, but they would not make the attempt after they had felt the barbs. I have had cows that have got scratched by going under a barbed wire, and if a rail was put up so high that they could go under it very easily, they could not be driven under that rail, they were so afraid of getting their backs scratched.

Mr. CHEEVER. There is one point that has not been touched upon this afternoon in connection with the barbed-wire question. I have hesitated to introduce it, rather hoping some one else would. In my Western exchange papers I have noticed for several years past what I may call a prejudice against the manufacturers of fence wire in New England. Massachusetts has to take a great deal of scolding from Western farmers. They all favor the fence, but they condemn the manufacturers or the price — especially the price. I would like to ask the speaker, who I presume knows about these matters well, if there is any prospect that the price of barbed wire will be largely reduced, perhaps before very long, on account of the expiration of patent rights, royalties, or from any cause whatever; or perhaps another question may

be more proper: Is the price in any respect much too high now? For instance, I have been told that the price, eleven cents a pound, includes some four cents a pound royalty. That is what the Western people are complaining about. I think this audience would be glad to have this matter cleared up understandingly.

Mr. Smith. That question, to borrow a town-meeting phrase, is hardly "in the warrant," but I will say a word or two about the Western complaint. The inquiry comes, Will barbed wire be cheaper? Well, let us first consider the present price of the wire. I make the statement, which could be verified to any committee that might be sent from this Board to any manufacturer who is making the wire, that barbed wire is being sold with less profit to the manufacturer, derived from the royalty, than any one of the agricultural machines which you buy that pays a royalty. It is the bulk, the large quantity, that has made the disturbance.

It is called a monopoly. Well, I want to make one other suggestion: that, if the farmers of the United States, who desire to use the new article of barbed wire, had to deal with the claims of this man who owns this patent, and that man who owns another, they would not know when they were safe in buying the barbed wire. That is not "in the warrant," this question of patents; but if there is anything of value to the public, it is having these patents tested in the courts, which saves the farmers from the trouble and annoyance of meeting the different claimants who come forward and interfere with their right to buy what they think they have a right to buy, — of which they had some experience in the "drive wells." I have no hesitation in saying that the trouble arose from parties who wanted to manufacture wire fencing without paying anything for the patent, and it was very easy, with the sensitiveness on the subject that prevailed at the West, to make a great disturbance over a very small matter.

Mr. Myrick. When do the patents expire?

Mr. Smith. The patents are so interwoven with each other that I don't think any man could tell when they expire. One patent is dependent upon another. It has taken some time to get this invention into general use. Take the tele-

phone, which passed into extended use immediately after the invention. It was not so in the case of barbed wire. It lay along, year after year, before it passed into extensive use. Of course the figures read this afternoon show that it was remarkably rapid; but the first patent on barbed wire was pretty old before it began to bear fruit, so that it has not the length of time to run that the telephone patent has, and some inventions that are now before the public. But it will not be a great many years before some of the patents will expire. I cannot answer the question definitely, and I do not know any one who can, because the patents are dependent upon one another for their success.

Mr. HASKELL. I have about two hundred rods of wire fence; it is mostly the ribbon wire. I have also nearly a hundred rods of wire tacked upon an old post-and-rail fence. The first that I put up of barbed wire was on chestnut posts; afterwards I put up some on posts of the white willow, so as to have them grow. This year I bought fifty of the angle-iron posts, and put up some twenty-five or thirty rods of wire fence with those angle-iron posts. They have stood well, as far as the barbed wire is concerned. I enclosed a small piece near my cider-mill, to keep the stock from getting to the apples. I had a lot of plain telegraph wire, and I put two circles of the barbed wire, about ten feet apart, on those angle-iron posts, and interwove it thoroughly with this plain telegraph wire. Within three days, those angle-iron posts were turned in every direction; and I would say, that as far as I am concerned, I would not give twenty-five cents a cord for them for posts.

Mr. ———. All that has been said about the cheapness of this fence refers to the original outlay. I would like to ask how much it costs to keep that fence in repair. How often do you have to string those wires over?

Mr. HERSEY. I believe my neighbor has never done anything with his since it was put up. The first of it, I think, was put up four or five years ago.

Mr. HUBBELL. Mine that I put up three years ago is in perfect condition.

Mr. SMITH. Under ordinary conditions, it should stand from ten to fifteen years, without any occasion for repairs.

I can find, I think, in the vicinity of Worcester, fence that has stood for several years, — ever since the introduction of the wire, — and it is apparently as good as it ever was.

Mr. ———. I have had to straighten up my wires every second year since they were put up. The posts are twenty-five feet apart, which is too far. There is a difference in the two wires between the same two posts; when one wire will be straight, another wire will sag six or eight inches out of line.

Mr. Hersey What kind of wire is it?

Mr. ———. It is round, galvanized wire, twisted. It was put up eight years ago last spring.

Mr. Smith. Twenty-five feet is too great a distance to set the posts apart, for a permanent fence. The gentleman made a mistake in leaving out an intermediate post.

Mr. Hillman. The wires that I put on the trees are just as tight as they ever were.

Adjourned to evening.

Evening Session.

The meeting was called to order at seven and a half o'clock, Mr. J. B. Moore of Concord in the chair.

The Chairman. The lecture this evening will be upon agricultural machinery and implements. It gives me great pleasure to introduce to you one of the members of the State Board of Agriculture from its first foundation, the accomplished gentleman and friend of the farmer, Hon. James S. Grinnell of Greenfield.

AGRICULTURAL MACHINERY AND IMPLEMENTS.

BY HON. JAMES S. GRINNELL OF GREENFIELD.

The use of agricultural implements, coeval with the enforced cultivation of the soil by Divine command, — in sorrow, in the sweat of the face, and with thorns and thistles, — begins with the earliest date of recorded history; but thousands of years went by, and generation after generation, past numbering, returned to the earth from whence they came, and which they had painfully tilled, with but small improvement in the means by which they wrought out their daily living.

The rude instruments of husbandry sculptured on Assyrian walls and Egyptian tombs were continuously used by Eastern nations down to a comparatively modern date, and are not entirely given up yet in some portions of those countries; and even among those nations of Europe boasting themselves to be earliest the most refined and advanced in science and in art, their implements for cultivating the soil were rude, clumsy, unhandy and unartistic to the last degree.

That the early Greeks, for instance, to whom we are constantly referred for examples of marvellous beauty in architecture, sculpture and painting, of wondrous eloquence, poetry and philosophic learning, had among them mechanics of the highest skill, is manifest by the magnificent armor and equipments of war as described by Homer, Hesiod, and later by Virgil, and by the exquisite gems and jewelry constantly found beneath the soil of that classic land, showing us in their refined savageness those ever-present traits of an unchristianized people, a special devotion to the art of war and to their personal adornment.

It certainly seems strange that a people who lived among such matchless architecture as their shrines and temples, who gazed on the exquisite statuary of Phidias and Praxiteles and the lovely paintings of Apelles, Zeuxis and Parhasius, who applauded the grand tragedies of Æschylus and Sophocles or the eloquence of Æschines and Demosthenes, who drank inspiration from those fountains of philosophy and wisdom, Socrates and Plato, should have so entirely neglected the art of agriculture and the cultivation of the soil; and in that occupation of life which furnished them their daily sustenance should have bestowed no thought nor care to improve the means by which it was procured. They, whose soldiers wore elegant armor and carried highly finished weapons, whose nobles and women wore curious and exquisitely wrought jewelry, scratched the surface of the soil for the reception of the seed, as their ancestors did, with the crooked limb of a tree, harvested the crop with an indifferent reaping-hook, threshed it under the slow tread of the muzzled ox or the livelier movement of horses on a chariot,

winnowed it with the wind of heaven, and finally ground it by the slow process of the hand-turned millstone.

Nor had the Romans, a century later, with all their boasted triumphs in war, law, science and the arts, progressed much further in the mechanical appliances of the farm. The improvement in farming tools was very slow till well down into the seventeenth century, and has been more rapid and positive during the past hundred years than in all previous time. Virginia, as early as 1610, had a glass house, smelting furnaces, and manufactories of pitch, tar, potash, and some other articles for domestic use and exportation. Within twenty-five years from the settlement of the Colony of Massachusetts Bay, the people had built mills, discovered the existence of iron ore, erected furnaces and commenced the manufacture of various articles, among which were some farming tools, so that the origin of American agricultural implements may almost be said to have been commenced with American manufactures, at the settlement of the country.

This event carries us back to a period anterior to the discovery and application of nearly all those great instrumentalities in science and mechanism which have revolutionized the industrial aspects of the world, and controlled its social, moral and political condition.

At that time the latent energy of steam, and the subtle agency of the electric fluid were scarcely suspected; the cotton-gin, power-loom, spinning-jenny, mowing, reaping, and sewing machines were unimagined. The lucifer match, illuminating gas, and the photograph, with an infinity of applications of the principles of nature now most familiar, were then unknown, and the great discoverer of the law of universal gravitation was himself unborn.

Indeed, brief as the intermediate period has been, compared with the ages of the past, it covers nearly all the improvements that now are deemed of the most essential importance. The art of printing, it is true, had been discovered, but stereotype plates, cylinder and power presses, lithographic and other forms of engraving, and most of the improvements which have made "the art preservative" the most

potent agent of civilization, are of most recent origin, and are children of the brain's later birth.

The mariner's compass had been invented, but the quadrant had not, and chronometers were unknown, while the thermometer, barometer, and even the telescope had hardly revealed their uses. Ship-building was comparatively a rude art, and the geography of the sea entirely unwritten.

Those great agencies of mechanical industry which have augmented a thousand-fold the productive power of man, and proportionally increased his comfort, as the use of fossil coal and the blast furnace in the smelting of iron, of gunpowder and steam in mining, of the flying shuttle, spinning-frame, power-loom, and carding machines, and improvements in bleaching, dyeing and stamping in the textile manufactures, and the wonderful discoveries in chemistry, analytical and agricultural, and the wondrous helps to farming, all belong to a subsequent period. Cotton, which now employs millions of people and millions of capital in its growth and manufacture, and furnishes the clothing for many more millions, was not long before regarded as a curious exotic. The fire-engine, safety-lamp, life-boat and life preservers, gas-light, the tourniquet and chloroform, and many other appliances for the conservation of life and property, were unknown in that era.

In short, whatever proficiency may have been attained in the arts of civilization in the early ages, we may say truly that their present development from a state of almost barbaric rudeness has been contemporaneous with the history of America, of which our manufactures form a large part, where, too, especially in later years, our agricultural machinery and implements occupy no mean position.

The first settlers in America brought with them to these shores a knowledge of most of the arts and manufactures of the parent country, as will be evidenced by a list of those sent over to Virginia and the Southern colonies, established under royal patronage, as well as those voluntarily settling in the more Northern colonies. Husbandmen, brewers, bakers, sawyers, carpenters, shipwrights, millwrights, ploughwrights, masons, turners, smiths of all kinds, coopers, weavers, tanners, potters, shoemakers, rope-makers, edge-tool makers, brick-makers, dressers of flax and hemp and

leather, lime-burners, men for iron works, mining, and for glass-making.

Many of these men were accustomed to the comforts, and even what were considered luxuries, in that era of civilization. Their primary wants in their new homes were those of subsistence, shelter and clothing; these could only be supplied by their own energy in subduing the unbroken forest and the virgin soil, which labors again required for their rudest exercise the implements of husbandry and other mechanical appliances, and these they began to shape for themselves as soon as the severest emergencies had passed, and the tools brought with them began to fail and be insufficient. To obtain the means of ameliorating their condition, the colonists, whose only wealth was the strong arm and the iron will, were forced to rely mainly on their own unaided exertions. This was particularly the case with the first settlers of New England, whose expatriation was a voluntary one in behalf of their principles, which left them without that support and patronage which watched over the more speculative enterprise of the earlier and wealthier colonists on the more southern territory.

The improvement in agricultural machinery during the first century and more of our existence, though much discussed and greatly needed, was slow. The early settlers were able, with such tools as they had, to raise and harvest crops enough for their support and some for export, but the inventive and mechanical genius of the new country was more absorbed in building houses, mills, factories, tanneries, glass-houses and ships, for shelter, clothing, and transporting from the country those products that would bring back into the country such necessaries and luxuries of life as could only come from foreign ports, than in devising easier methods of cultivating the land and securing the products of the soil.

But the advance in the agricultural development of this country, following manufactures and commerce, has for the past seventy-five years been very great, and is undoubtedly due largely to the creation and perfection of farming tools, implements and machines. The published transactions, during the first quarter of this century, of "The Massachusetts

Society for the Promotion of Agriculture," "The Philadelphia Society for promoting Agriculture," "The South Carolina Society for promoting Agriculture," and various other publications, show that the theory and principles of agriculture in the preparation of the soil, the seeding and cultivation of crops, the production of wool, and the care and feeding of cattle were about as well understood eighty years ago as at the present time; while in the practical results, it is doubtful if we equal in amount the crops then raised.

True, we have greatly progressed in breeding domestic animals, in the introduction of new and better varieties of plants, fruits and seeds, and in the use of special fertilizers, however much that may be; but as a single item, the improvement and manufacture of our farming tools, implements and machines seems pre-eminent.

During our provincial existence, the mother country endeavored to repress the growth of all manufactures, except such as would directly contribute to her commerce, and of the machinery necessary for them; but as soon as the people of the new country had partially recovered from the shock and the losses of the war, and realized their destitution of those articles, attention was turned to providing themselves with the necessaries of life from their own resources. With such tools as they possessed, or could be singly wrought out by the blacksmith or wagon-maker, their simple food could be wrested from the earth, but the requirements of a rapidly growing population demanded more speedy results than mere hand labor would furnish for clothing, building, and the many articles of household necessity or convenience. Accordingly we find, among the earliest, those directed to the raising of sheep for wool, the cultivation of flax, and the production of woollen and linen cloth, by machinery driven by water power. Flax was grown in large quantities in some parts of the country, and both that and wool were largely spun and woven by hand.

Cotton was first used about the middle of the century, and nearly as soon here as in England, but only on a filling with linen warp, and it was another hundred years before any weaving was done in a power-loom.

Mills for the manufacture of iron and for cutting nails had been early introduced, but had been discountenanced, and even suppressed by the British government, as had also the exportation from that kingdom of many other kinds of machinery, it being the settled policy of that government to force the colonists to buy their manufactured goods in the old country.

In 1810, Judge Peters of Philadelphia, one of the most eminent agriculturists of his day, and most patriotically zealous in his attempts to improve the agriculture of the country by his writings and practice, wrote an essay on the propriety of establishing an "agricultural implement manufacturing company," urging the necessity of it with great force, and saying that there was not in the country a manufactory of agricultural instruments in general; that although such implements as we have are often handmade, and intrinsically good, yet they were not easily obtained nor readily multiplied.

These wise suggestions, however, seem to have failed in producing any practical results. In the process of time, imperious necessity, aided by our system of patent laws, began to accomplish great ends. The first law for the protection of American inventions was in 1790. The first patent on record was issued to Samuel Hopkins for the manufacture of pot and pearl ashes. The first patent for spinning cotton by power, was by Pollard, in 1791; for powerloom, by Whittemore of Massachusetts, in 1796; and till within a short time previous to this, all the spinning and all the weaving of woollen, linen and cotton goods was by handpower. Among other famous inventions was that by Jacob Perkins, of a machine for cutting nails, in 1786, but patented in 1795.

In 1776, in Sutton, in Worcester County, was a gun factory, which after the war was converted into a manufactory of scythes, axes, and other tools; and before 1790, there were in that town five scythe, one axe, and one hoe manufactory.

In 1790, in Amesbury, Essex County, several kinds of agricultural tools were made in considerable quantities. In 1798, in Plymouth and Bristol counties, were fourteen blast

and six air furnaces, twenty forges and shifting mills, in addition to a number of trip-hammers, and a great number of nail and smith shops. Many branches of iron and steel manufacture had grown up in their neighborhood; and cut and hammered nails, shovels, spades, scythes, saws and other implements were made in large quantities. Charles Newbold took the first patent for an iron plough, in 1797. Oliver Ames of Massachusetts patented shovels and spades in 1811, and the same patterns are made to this day. At the Centennial Exhibition, in the same case, stood those made in 1811 and in 1876. Scythes were early made by machinery, probably the first agricultural implements in this country that were. The system of granting patents for new inventions, which is the great stimulus to improvement, had its rise in England early in the seventeenth century, and has been since adopted by most civilized nations. In the system of laws called the body of liberties, adopted by the general court of Massachusetts in 1641, was a law on this subject. It declared that there should be "no monopolies, but of such new inventions as were profitable to the country, and for a short time only."

One of the first applicants for exclusive privileges under this first New England code, was Joseph Jenks of Lynn, who came to the province in 1645, and in the following year presented a petition for a patent for a new application of water power to mills for various uses, including a saw mill. On the 6th of May, 1646, the court resolved "that in answer to the peticion of Joseph Jenkes for liberty to make experience of his abilityes and inventions, for ye making of engines for mills to goe by water for ye more speedy dispatch of worke than formerly, mills for ye making of sithes and other edged tools, with a new invented sawe mill, that things may be afforded cheaper than formerly, and that for fourteen years without disturbance of others setting up the like inventions, that so his study and cost may not be in vayne or lost. This peticion is granted so as power is still left to restrain ye exportation of such manufactures and to moderate ye prizes thereof if occasion so require."

This Joseph Jenks was a remarkable man, and might be called the "Tubal Cain" of this country, as he was the first

founder and worker in brass and iron on this continent, and he certainly was the first to make any agricultural implements by machinery. The first threshing machine patented in this country was in 1791, and was soon succeeded by many more. The war with Great Britain in 1812, however, stimulated invention and manufactures amazingly.

From 1809 to 1819, from twenty to forty patents were taken out on each of the inventions we have mentioned above.

The three great problems to be solved in the practical operations of agricultural machinery were: first to skilfully, effectually and cheaply prepare the ground for the reception of the seed, and to cultivate the growing crops; second, to harvest them; and third, after harvesting, to prepare the various grain crops for use or transportation.

Of the first, the plough, as the most important, takes the precedence of all others, having been used time out of mind as the symbol of agriculture, and as the most ancient and common to all ages and countries, as far as is within our knowledge of history.

The plough and ploughing are early mentioned in the sacred writings. Perhaps the most notable passage is that in the book of Kings, where Elisha, when called to prophesy, is represented as ploughing with twelve yoke of oxen,— upon which an old Dutch commentator remarks, "that if Elisha had such 'breaking up' to do, it was no wonder he quit farming and turned to preaching."

For hundreds of years, the plough was, while the most necessary, yet the most clumsy of all implements in use, rivalled only by the flail; and it is only about one hundred years since the old-fashioned mould-board, hewed from a plank and shod and strengthened by iron straps, was superseded by a cast-iron ploughshare.

But little advance had been made in the old country, when Charles Newbold of New Jersey, in 1797, patented the first cast-iron plough ever used in this country; "being of solid cast-iron, consisting of a bar, sheath and mould-plate, serving for share and mould-board; that is, to cut and turn the furrow."

Jethro Wood of New York, in 1819, was the first in this country to cast the plough in sections, so that the part most exposed to wear might be replaced by another cast from the same pattern. Large numbers of ploughs were made from patterns furnished by him, and even to this day there are many ploughs made in various parts of the country, which depart very slightly from the principles established by him, which were the peculiar lines of the mould-board. There can be no doubt that this plough became very popular, and did more to drive out the wretched and clumsy ploughs of the olden time than any other which had then been invented.

Mr. Wood was so harassed by infringers and by lawsuits, that he made nothing by this most important invention, and died poor. Many years after, the legislature of New York, in consideration of the immense benefit from his invention to the people of the country, donated the sum of two thousand dollars to his daughters.

From this time the iron plough became a success, and hundreds of patents have been issued for improvement in the curves and lines of the mould-board, the form of the beam and landside, the cutters, wheels, and various attachments for easing and regulating the draught.

The "swivel" or "side-hill plough," or, as it is termed in Scotland, the "turnwrist," has been used in Kent, in England, for more than one hundred years, and, as modified for use in our country, is one of our most useful implements on flat lands, as on side hills; the furrows can be turned in the same direction whether going or coming, the hateful "dead furrow" is avoided, and the team is a little rested in turning.

One of the earliest laborers in this field was Thomas Jefferson, formerly president of the United States, who, in a communication to the French Institute, attempted to solve the mathematical problem of the true surface of the mould-board, and to lay down intelligible and practical rules for its formation for the first time. He saw very clearly, and was the first one to discern with distinctness, that the plough should consist of two wedges, one acting vertically and the other laterally, which should be so blended in a curved surface

that the furrow should rise and turn over smoothly and continuously.

There can be no doubt that Mr. Jefferson is solely entitled to the honor of inventing the first mould-board made on mathematical principles.

In 1790, he mentions that one of his nephews, Col. Randolph, had invented an ingenious and useful plough for turning the furrows on a hillside in one direction, and gives a sketch and plans for making it which shows that he very clearly understood the principles of the plough.

These, as well as the straight ploughs, have been constantly improved and beautified in shape and lines.

The next step in advance in ploughing or turning up the soil for cultivation will be to accomplish the operation successfully and economically by the use of steam. While great labor and study and much money have been expended on this matter, it must be confessed that so far it has been but partially successful.

The great desideratum, which has at several periods during the past forty years seemed just to have been reached, has failed, and after great expectations we found disappointment. That was to drive the ploughs by locomotive power; to construct an engine powerful enough to drive or draw a gang of ploughs or diggers, and yet not so heavy but that it could be moved fast enough to plough profitably. We believe the time will come when it will be found possible and practicable by our greater knowledge of the application of forces to construct an engine capable of not only running over a common road, but in a cultivated field, where the entire power of the engine shall not be expended in its own propulsion, but have the ability to overcome the resistance of the ploughs. The most notable failure of this attempt was that of John W. Fawkes of Lancaster, Pennsylvania, who invented and constructed an engine capable of drawing eight ploughs, which on a hard sod seemed to accomplish wonders, ploughing at a rate of over four acres an hour. It has never done it since.

So far, the only successful steam plough has been that patented by John W. Fowler, in England, in 1854, and in

this country in 1856, or by inventions and devices similar in principle.

This consists in hauling the ploughs back and forth across the field by a stationary engine placed on one side of the field, which, however, can be moved as occasion requires. On the other side is a movable capstan, around which ropes or chains pass from a drum on the engine; the ropes are each fastened to the frame containing the gangs of ploughs facing in opposite directions, and which are thus drawn back and forth. This, though successful, is very expensive, and cannot be profitably used on a farm of much less than two hundred acres of arable land.

So much for ploughing; but the plough, though hallowed by antiquity, the beginner of all earth cultivation, the chosen and long accepted emblem of agriculture, is essentially imperfect.

It has helped toward cultivation, but whatever it has done, has been and is accompanied with a radical imperfection, and that is the damage by the compacting of the subsoil, which is pressed and hardened by the sole of the plough in an exact ratio with the weight of the soil lifted by the share, in addition to the force required to effect the cleavage and the weight of the instrument itself. The invention and use of the subsoil plough are standing witnesses against the plough. The plough, as now used, turns up or over the sod or stubble in a more or less complete manner, dependent on the skill of the ploughman, the steadiness of his team, and the various conditions of the land to be worked, to the depth of from three to seven inches, delusively believed by the honest man who stands between the stilts of his plough all day long, watching it heave the furrow slice so nice and smooth, and swelling the rich earth as it hurries along, to be from seven to eleven inches. Other instruments pass over it again and again, to make of the rudely upturned furrow a seed-bed fit for use, which is just what we need and must have for success; but they are drawn by teams, tramping, treading and compacting the lightened soil.

Why should we not have an implement which, propelled by some power, should, acting like the tines of a fork or claws of a rabbit, woodchuck, or a mole, tear up, invert and pulverize the soil at one operation, acting probably with a

rotary motion, leaving the land in the most perfect condition to receive the seed, whatever that may be.

Ploughing is really but the first of a series of means towards producing a perfect seed-bed. That the plough is not going out of use in this country is proven by the fact that, in 1879, there were made 1,326,123 ploughs.

Next to the plough in the preparation of the soil comes the harrow in all its present different forms; though practically the harrow in most common use is much the same in principle and construction with that used thousands of years ago, — a frame of wood, filled with teeth of wood or iron projecting through the frame, long enough to comb down the irregularities of the furrow left by the plough. Special forms of a harrow designed to accomplish certain work more effectually have proved very successful, — among which stand prominent the disc harrows of "Randall" or "La Dow," now well known, which for cutting up freshly ploughed sod, or for working manure into any ploughed ground, are invaluable and worthy the highest commendation. So also is the "Thomas Smoothing Harrow," in which the teeth, many in number but small in diameter, are inclined backward and so arranged in the draught that every inch of the ground is stirred. One important use of this implement is in harrowing grain, corn or potatoes, soon after they are up; the ground is lightly stirred and the starting weeds uprooted or covered and destroyed, while the crops are not seriously disturbed. About 30,000 of these are annually made.

It is impossible to mention all the harrows, or the seed-sowers and planters which are next in succession in tillage. Where wheat is grown in large quantities, the general practice is to drill it in with ingeniously constructed machinery. Other grains are commonly sown broadcast; potatoes dropped by hand; Indian corn planted by a dropping machine, often drilled in, and on small farms still planted by hand with the ever-faithful hoe, which also does great service in the subsequent cultivation of the crop. We make about 80,000 seed-drills and planters annually. Horse-hoes and cultivators of innumerable forms, 320,000 in number, bear a large part of the cultivation of hoed crops and are all of very modern use, but now, in the cultivation of

the immense fields of corn, potatoes and roots in some parts of our country, seem indispensable.

Of all agricultural operations, that which for years seemed to baffle invention, and to stand in its original simplicity while other operations on the farm were lightened in labor and enlarged in capacity, was that of mowing and of reaping.

The lines of the plough had been lengthened and beautified almost to the perfection of the implement; harrows, rollers, clod-crushers and pulverizers for reducing the soil to the required condition for tilth; seed-sowers and planters for uniformly and rapidly dropping the seeds; horse-hoes, scarifiers and cultivators for cleaning and aiding the growing crops; tedders and horse-rakes for the hay crop; and for the grain, threshing and winnowing machines by the score had been brought forth and were multiplied; but the invention of man had not been able to conceive anything to supersede the original sickle and reaping-hook, and the primitive scythe remained just as Joseph Jenks of Lynn, in the province of Massachusetts Bay, made it in 1655, in which year he received a patent from the General Court "for welding a bar of iron on the back of the scythe blade to strengthen it and give it greater length, thinness and capacity of cutting"; and that scythe has descended to us of this day unchanged.

After many abortive attempts, both in Great Britain and in this country, to make a harvesting machine that would be satisfactory, the first really successful one was invented in Scotland by Mr. Patrick Bell, in 1827.

The history of Mr. Bell's invention and the difficulties he experienced in perfecting it and making a working machine is so interesting that I will give it in a brief form: —

In the summer of 1827, while on his father's farm where he had been brought up, having been recently graduated at a university, he was much impressed with the amount of hard labor in the hay and harvest field, and gave his whole attention to devise some way to lighten it. Scheme after scheme had been canvassed and been rejected, and he was almost in despair of accomplishing it, when one evening in his father's garden he chanced to notice a pair of hedge shears. His mind full of the subject, it flashed across him that there was the principle that must succeed.

Adjoining the garden was a field of unripe oats, in which he tried the shears successfully; but how to reduce this cutting principle to practical working, the great difficulty with most inventors, was his next and most serious study. He first prudently made a model to see how it would look and act. Having accomplished this, he next went to work on a machine, all of the woodwork of which he made himself; and he also made patterns of every bit of iron-work, every wheel, rod, bolt and cutters in wood, and sent them at different times and to different places, to have exact copies made by the blacksmith and the founder. These he had to fit up himself with files and chisels, so careful and fearful was he that some one would see or suspect his work. The machine was finally completed, but how was he to try its working power, unseen and unknown? It stood in his workshop, an unoccupied outhouse, long and narrow, with a bench at one end. On a quiet day, when few were about, with a wheelbarrow he covered the floor of the outhouse with about six inches of soil and tramped it firmly; then, selecting a sheaf of oats from a convenient stack, he stuck straws in the soil about as thick as they would naturally stand if growing; then going behind his machine he pushed it forward with breathless anxiety, relieved only by seeing the straws perfectly cut. Much yet was to be done to complete it according to his ideas. A reel must be attached, and an endless apron passing over rollers in front to catch and discharge the cut and falling grain.

These were all finished in the summer of 1828, and, scarcely waiting for the grain to ripen, he, with his brother whom he had taken into confidence, fearful of being seen and ridiculed, took out the machine and an old horse into a wheatfield about eleven o'clock on a dark night, when every one else was in bed, and after one or two trials they found it to cut the wheat perfectly and to drop it beside the machine; and they took it back to the shop in a happy frame of mind. This machine cut the grain on his father's and brother's farms for more than twenty years. Many machines similar were made, but most of them failed from some defect in the manufacture. A similar experience was had in our own State in 1858.

The Heath Mower took a thousand-dollar premium as the best machine in a competitive trial, arranged by the "Massachusetts Society for the Promotion of Agriculture," and there was never a machine of the same kind made that could do a day's work.

Although Mr. Bell's machine was the first that really performed practical work,— because he hit the only practical device, the shears-cut now used by all mowers and reapers which have been invented and which do efficient work,—many attempts had been made before his to mow or reap by machinery. In the first century of the Christian era, Pliny, the historian, writes that in the vast domains of the province of Gaul (now France), the grain was harvested by a machine consisting of a large, wide box with sloping sides, carried on two wheels, the front board being lower than the others, and having projecting from its edge a great many small teeth, wide-set, in a row corresponding to the heads of the grain, and turned up at the ends. On the back of the machine, two short shafts are fixed; in these an ox is yoked, with his head towards the machine. When the machine is pushed through the standing grain, the heads are caught by the teeth and dropped in the box behind, the driver setting the teeth higher or lower as the condition of the standing grain may require. After eighteen hundred years, the same thing is revived as a header for gathering clover seed; and it is also about the same length of time before any attempt was made to reap by machinery.

The first patented reaper was invented by Boyce, in England, in 1790, having six rotating knives swung beneath the frame of the machine. For forty years inventions continued to be made; but with no positive results, till Hussey, in 1833, invented a machine having all the essentials of the true reaper and mower. McCormick was next, and from that time to the present invention has never ceased, and patents almost without number have been granted for every different part which goes to make a complete mowing-machine or reaper. Of these machines, mowers, harvesters, reapers, and reapers and mowers combined, there were made the past year, about 180,000. A notice of reaping-machines would be incomplete without special mention of the

automatic binder, the most effective of which is made by the Walter A. Wood Company. It cuts the grain, drops it on the platform, rakes it into gavels, binds it with a string band, and throws the sheaf off for the gatherer; the most perfect agricultural machine ever made, and a marvel of the continued and combined ingenuity of many inventors.

Following the mower is the tedder, a most valuable instrument for spreading the cut grass, throwing it in the air and leaving it lightly on the ground more rapidly and effectively than can be done by five men with forks. This was invented in England, in 1816, but never used in this country till one was imported by the "Massachusetts Society for Promotion of Agriculture," in 1858; since that, several patents have been granted for improvements on it, and it has deservedly come into general use. About three thousand were made last year.

The horse-rake is comparatively modern even in England, and used in this country thirty or forty years, it is now regarded as a most useful assistant in hay-making, and they are made in great perfection. About 100,000 were made last year. Horse hay-forks for unloading are somewhat used, and for loading hay; about 10,000 machines were made last year.

The threshing-machine — next to the reaper in the practical operations of a grain-growing farm — was the outcome of necessity and invention long before the ingenuity of man had been able to solve the problem of cutting the grain by machine power.

Of all the implements of husbandry, the flail is the rudest and clumsiest to effect the purpose for which it is designed; and, though used for so many years, it is but a single step in advance of the primitive method of threshing, in the earliest recorded history of agriculture, sacred or profane; that of treading out the grain by oxen or horses.

The Romans, in addition to the treading of oxen, had them haul over the grain on the threshing-floor a heavy drag with spikes, or a roughened sledge called a *tribula* — whence our word tribulation. The practice of treading out grain by horses after the manner of the ancients was in use in this country as late as 1790, especially in the eastern parts of Virginia, Maryland and Delaware, and the planters there claimed its advan-

tages over the flail, as used in the Northern States and in England at that time, to be, that an entire crop could be beaten out in a few days, thus securing it from the ravages of the Hessian fly, which even then prevailed there, and also from thieves; and also that of having it earlier ready for market.

Three thousand bushels of wheat could thus be made ready for market in two days, which would employ five men with flails a hundred days. Treading-floors were made of a hard, waxy earth, which by use became firm, glossy and smooth. These were made from sixty to one hundred and thirty feet in diameter, with a path or track at the circumference twelve to fourteen feet wide, on which the sheaves were laid, usually fenced around, sometimes with an outer and inner fence. The horses were led round in ranks equidistant from each other, and in a sober trot; thus four ranks would preserve the relative position of the four arms of a wheel. Somewhat the same method was practised on the California coast, down to the time when the discovery of the golden grains in the raceway of Col. Sutter's mill gave the first start to that marvellous settling of the Western coast of this country.

As described by one who was there, and who afterwards became a member of Congress and one of California's most respected and respectable governors, it was thus: Col. Sutter had a large mill for the production of flour, for consumption along the whole coast line and for exportation. To supply his mill with wheat, he had hundreds of acres sown to that grain. When it ripened, — the season of ripening continuing, as it does there, for some weeks without rain, — he would send to the mountains for part of a tribe of Indians to come down and help reap it. The noble redmen would respond for a small compensation, and would come on to the number of fifty or a hundred. All the sickles and old swords that could be found were first taken; then sickles were extemporized from old iron hoops, and if more were wanted, willow shoots the thickness of a man's thumb were cut, pulled and split; when dry the sharp edge was sufficient to cut or break the stalks of wheat.

When cut, the grain was carried and thrown to the depth of about two feet in a corral containing a half-acre or more,

prepared for the purpose by setting in a circle in the ground posts ten or twelve feet high, and binding to these posts long poles with strips of green hide, which, when dried, held like straps of iron.

When this was completed, a drove of wild horses to the number of a hundred was brought in by the stockmen, and turned into the corral to trample out the wheat. These were kept in lively motion by the Indians, round and around the outer limit of the corral. After driving them in this direction a sufficient length of time, the order would be given to turn them, to tread the straw in a different direction; and then comes the acme of excitement. A hundred frightened horses are dashing around, and a hundred ragged redskins attempt to turn them; the horses kicking, biting, squealing, plunging, — the Indians, in the perilous endeavor to throw themselves in front, whooping, yelling and swinging their clubs in frantic endeavor to turn this mass of wild horseflesh, with sometimes an Indian down and sometimes a horse, but finally successful; all making a wild scene of life, never witnessed except in California, and seldom there.

Of threshing-machines — among the most necessary of our agricultural implements, from its importance as a means of economizing both labor and time — the first practical invention was by Andrew Meikle of Scotland, in 1786, which is the type of all modern machines. The winnower was added in 1800. Samuel Mulliken was the first American inventor, in 1791. In threshing-machines as well as in reapers, the American inventors, though subsequent to the English in their original principles, far excelled their brethren across the water in making improvements, rendering them much more convenient and practical in their operation. The American machines are much lighter than the English, much easier handled and run, much cheaper, and thresh more than twice as much grain, and clean it better; which was proved at a trial on Mechis' farm in 1853, at Tiptie Hall, in England. About 10,000 are annually made.

Having traced the excellent modern machines and implements for raising and securing the farmers' crops and separating the seed from the straw, the next valuable instrument which deserves attention is the winnowing-machine, or

fanning-mill as it is commonly termed, for separating the grain from the chaff.

According to all history, sacred and profane, the common and only mode of accomplishing this was by throwing the whole into the air by means of a long, shallow basket called a fan, at such a time as there was wind enough to blow away the chaff and dirt.

The first winnower containing all the principles of those in present use, was made in Scotland, in 1710, by Andrew Meikle, who brought the ideas from Holland which since, both in Great Britain and in this country, have been so thoroughly elaborated into the machine which has now become indispensable. It is among the histories of the machine that when it was first introduced in Scotland, certain sensitive persons denounced it as an impious device, "as it created a wind where the Lord had made a calm." Of fanning mills there were constructed during the past year about fifty thousand. Corn-shellers, both those worked by power and by hand, are, of course, an American invention, and of great consequence and utility. Thirty or forty patents have been granted in this country for this valuable machine since 1810, the date of the first.

A curious record with a drawing is among the English patents, as follows: "Letters Patent to Thomas Masters of Pensilvania — Planter, his Exrs. Admrs. and assignes, of the sole Use and Benefit of a New Invencion found out by Sybilla Mathews his wife for cleaning and curing the Indian Corn growing in the Several Colonies of America dated Nov 25th 1715." The drawing shows a set of stamps worked up and down by lugs on a horizontal shaft driven by a water-wheel, there is also the drawing of a kiln for drying the corn. Over sixty thousand corn-shellers are annually manufactured in this country. The grain cradle has performed a very important part in our agriculture, and apparently still does, as over one hundred and sixty-eight thousand are made every year.

This implement, or improvements in it, have been patented many times since 1800.

Its origin is not given by any writer that I can find. Barnaby Googe, in his "Historie of Husbandry," in 1584, says, "besides sickles with a toothed edge, where the grain is tall

they use a large scythe, with a long handle fenced with crooked sticks, which they swing with both hands."

As an agricultural machine, none has ever been invented which has surpassed the cotton-gin in its importance, from the change it has wrought in the cultivation and production of that great staple so long vaunted as King Cotton, by which the clearing of the lint from the seed was increased in production from the four pounds by hand, or twenty-five by the old roller-gin, to one thousand pounds daily.

In the cultivation of potatoes one of the most expensive items is the digging or lifting them from the ground. Several patented machines were exhibited at the Centennial Exposition, but none seemed to the judges worthy of commendation, yet the thirty-five thousand made last year show that there must be an appreciation of them somewhere.

The improvements in every branch of dairying have been such as to have almost revolutionized the management of milk in making butter and cheese, both of which are now largely and successfully made in creameries or cheese factories. Churns to the number of over two thousand have been patented since 1803; some of them with strange devices, and more than one, as a labor-saving machine, has a rocking-chair combined with a churn; milk-pails, strainers, shallow pans and deep pans, milk-cans, coolers and creamers with submerged pans and with open pans exposed to an iced atmosphere, butter-makers and moulds, cans for collecting cream and milk, machinery for making butter and cheese in quantity, cases and packages for sending choice butter to market, and hundreds of devices, not imagined twenty-five years ago, have been patented, and used or discarded as they were proved valuable or worthless.

Forty-five thousand corn-huskers annually made show a considerable use of that convenient machine. One, patented by Phillip of Stockport, New York, works very successfully, accomplishing the work of four or five men; the ears of corn are dropped from a hopper on one or two pairs of gently inclined iron rollers having iron studs projecting about a quarter of an inch, running in a spiral direction around each roller; as these rollers are made to turn in or toward each other, the husk is caught by the studs, stripped clear,

and discharged underneath the machine, while the husked ear passes clear off the ends of the rollers.

Machines for distributing special and also liquid fertilizers have been long used in England, and to a limited extent here; but I think the first practical machine to spread barn-yard manure, long or short, or compost, is the Kemp Manure Spreader recently invented and introduced, and seeming to do its work satisfactorily, especially if used in spreading from a heap in the field drawn out the previous season, doubtless the best practice.

It seems strange that the dump-cart now so commonly used with a pair of horses should have only come into use within the last twenty-five or thirty years. While we have had our ox-carts and one-horse carts which unloaded by dumping, we could only use a pair of horses on a wagon, as there has been no device for resting the neap of a cart on the backs or necks of horses.

Whoever the man was that had the genius to cut off the neap of his ox-cart about half-way, and by putting in a king-bolt through the end into the axle of the fore wheels of his wagon, to make a cart easily drawn by horses, to turn handily, and to dump the load readily, he deserves to have his name perpetuated. Our neat and handy carts and wagons contrast with the necessities of the early settlers, and most strongly with those of Virginia and Maryland, who lacked the all-conquering, persistent energy of the colonists of Plymouth and Massachusetts Bay.

The transportation of tobacco in the absence of travelled roads is thus described in "Beverly's History of Virginia."

The tobacco was very solidly pressed into large hogsheads; in each end of these, through the heads, was driven a round pin, some two or three inches in diameter, with a square, sharp point; each pin projected some eight or ten inches from the head, and on these, forming axles, was attached by withes a rude pair of shafts made from saplings, and thus the hogshead of tobacco was trundled like a great roller, from the interior, miles to the seaport for shipping.

Of the countless small tools we use on the farm, I have said nothing; they generally have no history, except as being improvements on the rude instruments used by the succes-

sive generations that preceded us. Suffice it to say, that in lightness combined with strength, ease of working, efficiency for their intended use, and beauty and style of finish, our farming-tools are vastly superior to those of any other nation on the face of the earth, the farmers of Britain not excepted.

One very noticeable feature in the use of most of our agricultural machines is the driver's seat. I believe this was first found on the reapers and mowing-machines, and has now grown on all our rakes and tedders, on sulky or gang ploughs, on harrows and rollers, on seed-sowers and planters, on horse-hoes and cultivators, and on every machine where it can be perched, in entire contrast to the customs of all other nations, none of whom have ever made use of the seat on any machines except those that originated in this country. It was a necessity on the mowing-machines, and has been continued on the others as a convenience, and probably it is on most machines a matter of economy. A man will much easier manage his team when riding than walking behind or beside it, and it husbands the man's strength without any great strain upon the horses.

The value of the agricultural machinery and implements in Massachusetts, as shown by the census reports of each decade, are: for 1850, $3,209,584; for 1860, $3,894,998; for 1870, $5,000,879; for 1875, $5,321,168; for 1880, nearly $6,000,000; a very gratifying growth.

The increasing annual products of agriculture in our highly favored country, and the hay and grain crops in particular, furnish striking illustrations of the close interdependence and connection of all branches of the national industry. The dependence of agriculture upon the results of mechanical skill, as well as the astonishing progress of the latter within the last seventy-five years, is strongly exemplified in the application of labor-saving appliances in all the operations of the farm. Our own progress in this respect is more rapid than that of any other agricultural people, and at least co-equal with our application of the fruits of purely scientific research in the improvement of agriculture.

In every department of rural industry, mechanical power has wrought a revolution. The greatest triumph of mechanical skill in its application to agriculture is witnessed

in the instruments adapted to the tillage, harvesting and subsequent handling of the immense grain crops of the country, and particularly on the great plains of the West.

The two all-important elements which have been combined to improve, elevate and sustain our agriculture, enabling us from a hard and reluctant soil to draw not only our own sustenance, but such a surplus as has made us strong and prosperous, are, agricultural chemistry and agricultural implements and machinery. The chemistry of agriculture has taught us, first, the importance of draining and subsoiling, loosening and aerating the hidden depths of the soil, that plants may there find proper moisture and sustenance; it has taught us somewhat the mysteries of plant-life, and how plant organisms are developed to full maturity; it has taught us that plants do not obtain all their elements of growth from the mingled rock-dust and humus which constitute soil, but, wonderful as it may seem, they draw from the atmosphere almost alone solid forms of plant organisms; it has taught us respecting the offices of the soil, the rain, the air, heat and moisture, in accomplishing the development of plant-life; it also teaches us that in supplying the food necessary for vegetable growths, different plants require different nutriment.

It has clearly and minutely explained to us the nature of fertilizers, and how they become plant food, and wherein consists the value of our farm-yard manure, and how it may be supplemented in another form by chemical elements which, when applied, nature assimilates to the want of the plant. It has taught not only how to use these special fertilizers, but also to distinguish between those which are genuine and valuable, and those which are fraudulent and worthless. In a word, agricultural chemistry has done more than any one thing else during this century to elevate the hard-working but intelligent farmer from a mere imitator, in his cultivation, of those who went before him, to be a reasoning, thoughtful manager of such elements as are under his control.

And these teachings have not been confined to the laboratory, nor reserved only for the learned and wealthy; as they have by slow degrees been brought to the general comprehension of the farmers, those principles and doctrines which but a few generations since were utterly unknown,

and in the succeeding ones derided and ridiculed as book-learning and fancy farming, have now become a part of our common education, and are taught to the children in the schools and applied by the fathers on the farms.

While the acquirement of this scientific knowledge has tended to elevate and expand the ideas of the farmers, improved machinery as an adjunct has enabled them to employ more brain work in the management of their farms, at the same time reducing the amount of the severest physical labor, while increasing their productiveness.

For of what avail would be the largest accumulation of scientific theories without the means of carrying them into practical operation and making them available for our necessities? They would be like those beautiful visions which sometimes appear to the exhausted traveller on a desert plain, when famished with thirst, tempting him with a delusive view of "water in a dry and thirsty land where no water is," as unapproachable and unattainable as the fair fields of the "promised land" were to the prophet, sage and warrior, who from Nebo's lonely mountain longingly gazed at them with the melancholy consciousness that they could never be within his occupation nor under his control.

While agricultural chemistry has shown us the *possibilities* of improvement and success in our farming, agricultural machinery and implements have given us *opportunities* which we have so largely and successfully used in combination with our scientific knowledge, as to have placed ourselves and our Commonwealth in the foremost rank of scientific agriculture in the United States.

The Chairman. If any gentleman has any questions to ask Mr. Grinnell, he will be glad to answer them, or if any one has any remarks to make in regard to agricultural implements, now is a good time to make them.

Mr. Hillman. I would like to ask Mr. Grinnell if he knows a good corn-planter, that will plant corn well and drop the fertilizer at the same time.

Mr. Grinnell. We had one in the valley here, and it is used somewhat now. It is the Woodward or Blaney machine. One was an improvement on the other. It would drop fine fertilizers, like ashes, reasonably well. I under-

stand they are used somewhat now. In front of the seed-box was a large box that would hold perhaps half a bushel; in that was a little roller which revolved just enough to stir up the ashes by a motion from the side-wheel. The ashes, or fine fertilizer, or plaster, was dropped down into the furrow, the earth fell over it, the seed then fell upon the top, and was covered by the small roller. That is the only hand-machine that I know of personally. My idea is that a machine for dropping fertilizers with grain and corn is used in England extensively in planting operations.

Mr. ———. Is not the fertilizer likely to kill the seed if it is dropped in the same line with the seed?

Mr. Grinnell. It is intended to have the earth cover the fertilizer.

Mr. ———. The Albany corn-planter drops them both.

Mr. Grinnell. Mr. Bowditch has an excellent corn-planter, which does not drop the fertilizer, I believe.

Mr. Bowditch. My planter is merely a Western drill. I have tried the Albany machine, and it did not strike me as a perfect machine. This machine that I have, plants just one acre per hour, and it not only plants it, but the weight of the machine, the wheels going directly over where the corn is planted, rolls it so hard that the crows cannot pull up the corn.

Mr. Ware. May I say a word about the Ross machine? I have a corn-planter made by Ross, of Northfield, Mass. This machine will plant the corn and drop the fertilizer, either in drills or in hills, as fast as you can furrow out the land. About an acre an hour, I should say, was the speed. It will make furrows equal distances apart, and you may drop three, four, five or six kernels in a hill, or you may drop it in drills continually. I plant my ensilage corn with it very satisfactorily. I have used it for several years in planting corn and beans. It is designed to plant all sorts of seed, but I would not recommend it for other than beans and corn.

Question. Will not stones trouble it somewhat?

Mr. Ware. Small stones would not seriously interfere with its operation. Large stones would of course interfere with the roller. The land I use it on has no large stones and no serious obstructions. Very rocky land, of course,

it would not work on to advantage, but in good tillage land it works very satisfactorily.

QUESTION. What is the cost of the machine?

Mr. WARE. I think the price is seventeen dollars; it will last a life-time. It would be necessary to reduce Peruvian guano, somewhat, but most of the fertilizers it would be safe to use as they come from the manufacturers. They may be distributed with the corn and covered with earth compactly.

Mr. FIELD. I would say that the Ross planter is the old Woodward patent. There is no patent on it now. Five or six dollars would make the machine a good deal better than Ross ever made it.

Mr. ———. I have a Blaney planter which does the work well when a man is in a hurry. It has been used in the valley, ten years at least. It drops fertilizers in a way very similar to the one described by Mr. Ware, and better than the Woodward. I used that twenty years ago and threw it aside. This Blaney's planter does its work very well; but when it begins to get loose or out of order, it will not drop the number of kernels which you adjust it for. It is like a great many other farming implements — before they appear to be worn out they fail to do the work satisfactorily. I have one that has been in use six or seven years, and when the corn comes up, it does not come up as we expected. Sometimes there are three kernels and sometimes four. If we adjust it for five or six, we are not sure of getting the right number. But it works satisfactorily when it is in good order, and will drop the fertilizer. As Mr. Ware remarks, it would not be safe to put in the most concentrated fertilizers, because it is liable to touch the kernels of corn, although it is calculated to drop it just a little way from the corn so as not to hinder the germination of the seed.

Mr. BILLINGS. For the last two years, there has been sold an improvement on the Blaney planter, by using an iron wheel which will not wear so much, and also by adjusting it so that the fertilizer is dropped a little one side of the seed.

Mr. HASKELL of Deerfield. There is a Sturbridge sower

that will sow fine fertilizers; and also, for a fine dry fertilizer, there is an attachment made that does very good work in sowing plaster, etc.

Mr. Bowditch. There is another one that has been used a good deal in this State. I think it is called the Seymour Broadcast Sower. That is supposed to sow grass-seed and grain, but it is not made quite carefully enough. It sows fertilizers very well. I have used it for five or six years.

Mr. Grinnell. Don't you have to grind the fertilizer?

Mr. Bowditch. You have to work it up a little.

Mr. Russell. I was surprised that Mr. Grinnell did not bring his essay down to the sulky-plough.

Mr. Grinnell. I mentioned it.

Mr. Russell. I know you mentioned it, but you did not give an account of the invention.

Mr. Grinnell. I simply alluded to it generally. I did not think it proper in an address like this to speak of any machines particularly. I did, however, speak of two or three machines, as you noticed, which I thought I had a right to do, because they are specialties, and there is only one of each. I referred to the disk harrow, the La Dow harrow, the Randall harrow, the Thomas smoothing-harrow, and the Kemp manure-spreader. I thought I might speak of those without running the risk of appearing to advertise any of them. I know of two sulky-ploughs, the Cassady, and another one, introduced this last season, which I have never seen used. Perhaps Mr. Haskell can tell me the name of it.

Mr. Haskell. That is the Buckeye attachment.

Mr. Grinnell. The Cassady is the one where the axle is turned, is it not?

Mr. Haskell. Yes, sir.

Mr. Grinnell. The other was a sulky with two wheels, and with an ordinary plough attached underneath, an arrangement being made so that you can take any straight-beam plough and put underneath it. It seemed to be convenient, and those who had used it said that it worked to excellent advantage.

Question. Are the ploughs of the present day better than they were twenty-five years ago?

Mr. Grinnell. It is the general impression that they are.

Mr. ———. Take the side-hill plough, for instance. Twenty-five years ago we could not turn a furrow on a level plain with a side-hill plough; we did not attempt it. Now we can turn a furrow perfectly on a side hill, and we can turn it almost to perfection on a plain, and have it level. I think our friend did not give Kemp's manure-spreader quite enough praise. I have used it for three years, and found it a very admirable thing for putting out our manures. It will take our manures from under the barn, as they are usually found, even if they be so soft that we can just keep them in the cart, and spread them out in good shape, as I have done the past year, going over an acre in about three hours,—taking the manure from the barn, and going a quarter of a mile with it; doing it faster than you can drop the heaps. And it leaves the manure so nicely worked up and manipulated with the attachment, that it lies much more evenly over the surface, and your crop is really enhanced by the manner in which the manure is put on, being so much more evenly done, and being worked up so thoroughly. We find a great many hard lumps in our manure in the spring of the year. If it is put into this spreader, it comes out fine. On ploughed ground, where it is soft, you have got to take more time, unless you are going down hill. My brother puts horse manure on soft ground at the rate of about twenty loads an hour, with the help of two men.

Mr. Grinnell. I have heard some farmers complain that the Kemp manure-spreader did not hold enough when they wanted to cart out the manure. I have become satisfied within a few years — and I know this is the opinion of some of the best men I see before me here, and I have heard them advocate it — that the better way is for the farmer, in the fall and winter, when there is usually time to do it, to haul the manure out, and put it in a pile on the field. When you can do that, then you can take a manure spreader in the spring, and spread that manure on your field with great rapidity. Two men will spread it as fast as a man can load the manure. A load can be driven to the lot, and unloaded in two or three minutes, while the other man

is scraping up the manure. Worked in that way, it spreads the manure remarkably well.

Mr. Haskell. Do I understand the gentleman to say that he, with two men, loads and unloads twenty loads an hour? If he does, where does he live? I want to go and see him work.

Mr. Noble. On the question of Kemp's manure-spreader I would like to state what I have done myself. I have had only one experience with that spreader, and that was last spring. I spread two hundred loads with it in two days. The manure was drawn out on the edge of the ploughed land and left in piles. Not being able to own one of the spreaders myself, I hired one of a neighbor at two dollars a day. I wanted the worth of my money, and I think I got it. I had four horses on the cart, and four men to load. The man who drove did nothing else. The four men loaded and stayed at their heaps; and the man with his four horses brought it out and spread it. In the two days we drew out our two hundred loads, and returned the cart back. I was glad to get the use of it for two dollars a day. We don't work by the hour up in Berkshire, but begin as soon as we can see, and work as long as we can see.

Mr. J. W. Pierce. I would inquire if there is a successful potato-planter in the market — one that will cut, drop and cover the potatoes?

Mr. Ware. Drew's potato-planter has been used quite a number of years, and quite successfully. It cuts the potatoes, drops them, covers them, and does it very well. I suppose for a small patch, it would not be desirable to get it; but if anybody plants potatoes largely, it would be very desirable to have one of these planters. Mr. Gregory of Marblehead has used one for some years, and he speaks of it in very high terms.

Mr. Sedgwick. There is an objection to the planter that has just been mentioned, in the fact that it does not cut the potato evenly; but there is a potato-planter (I cannot recall the name of it) which is used largely on Long Island, that drops the potatoes after they are cut. They are cut by hand and then put into the machine, which drops the potato and also the fertilizer. It works very successfully. It is

not a very expensive machine; I should say not over twenty-five dollars; probably not as much as that. I have seen it several times.

I would like to ask Mr. Grinnell if he knows of any swivel-plough that will do good work on level ground; as good work as an improved right-hand plough, the conditions being equal?

Mr. Hillman. I saw a plough working not more than a week ago on level land, and it was doing as perfect work as any farmer need ever wish to see done. That was the XL. I use on my farm the Centennial, and I have no difficulty in instructing green hands in the course of a season so that they will do work which agricultural college graduates pronounce premium work.

Mr. Grinnell. I have used side-hill ploughs of one kind and another for more than thirty years. I was trying to think, while Mr. Sedgwick was speaking, of the names of some of them. The one I am using now is the Belcher & Taylor. That plough does good work. It turns a furrow as well as any plough. It is good enough. It turns a furrow to suit me. My ploughing is all done in the fall. I don't have to do it in the spring, and I want those furrows turned and set up on edge, so that the frost and the weather shall operate on the furrow slice. I don't want them turned over flat with the sod clear down on the ground. I may be wrong. There are different ideas about ploughing, and it is a good time now to have it out.

Mr. Stedman. I have used a swivel-plough that does very good work in turf land, but not quite satisfactory to me in stubble land. It leaves the furrows too much as Mr. Grinnell has described, up edgewise. It does not turn enough. I have never been able to get a swivel-plough that does turn enough to suit me on stubble land. Whitman, Barnes & Co. have advertised what they call a perfect swivel-plough. I have never tried that plough, but I have tried other ploughs of their make, and my impression is that they have as good a swivel-plough as is made, with the exception that, two years ago, a man by the name of Saxe, in Connecticut, invented a plough where one man rode on top of the beam, while the other was doing the work.

That is the only perfect working swivel-plough I have been able to find yet.

Mr. WATERMAN. I have used almost all kinds of ploughs within the last forty years. I have never yet been able to hold a side-hill plough, or follow one that would run eight feet without falling down. I never saw a side-hill plough that would turn a furrow bottom up. With any side-hill plough that I ever saw, you must put your foot on the land to keep it up straight, or it will tip over.

Mr. WELD. An allusion of Mr. Sedgwick makes me think of a side-hill plough which has recently come out. A German came to see me for the purpose of consulting me in regard to putting a plough on the market. He brought his plough with him. It was one plough riding on another. The beam rested on a little carriage, as is very common in Germany. He sent that plough to my place, and it did excellent work. The plough would hold itself. You could let that plough go for rods without touching it, and it would turn the furrow bottom up, if you set it for that kind of work. He took the plough to the New York Plough Company, and they made him some ploughs with that little iron carriage in front. That was an objection; it made the thing costly, but it would run alone. That was the great point with the plough; any child could hold it, and at the end of the furrow, it could be turned round very easily. Still, the horses did not come quite up to the fence; it left a little space. He worked away at that until he perfected a plough which will turn in that way without a carriage, and that plough is now made by the New York Plough Company. I used the plough last year. A man that I got in New York, for pretty low wages, was instructed in the use of the implement, and he did just as good ploughing with that thing as had ever been done on my farm; but the bolt that united those two ploughs was not strong enough, and broke once or twice. Now, after the experience of a year or two, the thing is better. But that is a perfect side-hill plough. Of course, the model of the plough can be whatever you prefer. They put two very good ploughs together. They are called the twin ploughs, and there is a very ingen-

ious arrangement by which the draught is not required to be regulated as the plough turns over.

Mr. Grinnell. Isn't it tremendously heavy?

Mr. Weld. No, it is not heavy; the draught is light. The ploughs are pretty reasonably heavy, too; but the addition of a few pounds of extra weight does not affect the team essentially.

Mr. Hillman. The gentleman who was up before the last speaker has been so unfortunate in his selection of ploughs that although it seems to me that I am more conspicuous than I ought to be, I cannot refrain from rising. It does seem to me he is entirely mistaken in his idea that there is no side-hill plough that will do good work. I have had on my farm the last three years a No. 2 Centennial plough. That plough will turn over a furrow, I don't care whether it is on turf or on old land, and lay it perfectly flat; and in the case of old land, the earth is so thoroughly pulverized that it is fit for planting without any harrowing at all, and the surface is perfectly level; it is turned entirely over. It is the best plough for ploughing turf or old land. I thought I had good ploughs on my farm before I got it. I bought it, not to work on land; I wanted to excavate for the purpose of building a barn, and I bought that plough for that purpose; but after doing that, I put it into a field to plough turf land, and I found, after getting the team properly attached and everything well arranged, that there was no difficulty in doing first-class work. It is just as useful in old land.

Mr. Hewins. I have used the Ellis plough, made up in Hinsdale, New Hampshire, for two years. I have used the Prout Self-sharpener for twenty-five years. The principle of the Self-sharpener, having two points, was devised by the Hon. William Clark several years ago. I ploughed two or three weeks ago on a side hill, up hill, with that plough, and turned the land over as well as I could do it with any other plough. It was a field that had been ploughed in the middle of summer, so that it was very mellow, and there was not so much resistance to the plough as where the ground is harder. I have used that plough altogether for two years to plough turf land and stubble land. I do not use any other plough now, because I prefer not to have any dead fur-

rows, and because this turns over the ground better than any other. My oldest boy says he does not have to use his foot so much in ploughing as he used to with the other ploughs, in kicking over the turf. If the gentleman who spoke is incredulous about it, if he will come over to my place, if it don't work as I say it does, I will give him the plough.

Mr. WATERMAN. He says his plough will turn the sod bottom upwards; then he says it will turn old land equally well. Now, I never saw any sward-plough that would pulverize old ground. It takes a different plough to plough sward-land from what it does to plough stubble-land. Prouty & Mears' plough will not turn old ground, because it does not give it motion enough.

Mr. MOORE. I take a good deal of pride in my grass land, and some six or seven acres of that land is re-seeded on the sod every fall. To do that properly it must be well ploughed, and I have used for the last six or eight years, nothing but a swivel-plough to do it with. I have used simply the Holbrook plough, which some of you might condemn. The man who works for me is a good ploughman; he can hold a plough and manage his horses very well. I sent him out some three years ago to do ploughing, and he came back to me and said, "I can't do anything with that plough. It will turn the furrow one way well, but coming back it won't do it." I went out to the field and said to him, "You ought to know better than to be ploughing in this way." It was not half ploughed. He says, "What is the matter?" Said I, "You are a good ploughman, you ought to know what is the matter. In the first place you have got a good plough, but you have got a pair of short eveners. You ought to know better than to blame this plough because it don't give you the right draught." He got the long eveners, but still the plough did not work very well.

Then said I, "We will look a little further. I know that plough can do good work." It has an adjustable cutter; as that moves, you change the mould-board. I took a monkey wrench and fixed that cutter as it ought to stand, and it will turn old grass land by the acre so that you shall not see

one spear of grass left where the rowen had been eight or ten inches high.

Oftentimes people tell us that the land-side ploughs or the swivel-ploughs that they use, do not work. Well, it is their fault, because they do not know how to put the plough in order. Not one farmer in ten knows how to put a plough in order to have it do good work. The Holbrook plough does work perfectly on my land, and the man does not wear out a pair of boots in a season, in kicking the furrow over, either. There is no difficulty about doing it, if the plough is put in proper order. The land is ploughed from seven to eight inches deep. Mr. Cheever knows whether my land is smooth or not, and any one else, almost, in the eastern part of the State.

I think there are many good ploughs. Probably there are other swivel-ploughs that will do work just as well as the Holbrook plough. A more perfect furrow can be turned by some of the land-side ploughs, but a swivel-plough will do the work sufficiently well, better than most of the ploughing is done, and it will do it without leaving any dead furrows. The advantage of getting rid of the dead furrow is enough to compensate for any little deficiencies that it may have. That is my own experience.

Now, that same plough will not turn stubble ground. No plough that will turn sod well, will turn stubble ground well. Why? Because the resistance being so much less in stubble ground, it requires a shorter mould-board to turn it over well. Every farmer knows that. Now in ploughing in the garden for the late crops (I have thirty-five acres under cultivation), we use a small swivel-plough which has a short mould-board, and it does its work well; there is no difficulty about it. All my onion beds, strawberry beds, and everything of the kind, are ploughed with a swivel-plough with a short mould-board. I believe I bought the last one that I had, two or three years ago, of the Ames Plough Company.

Mr. Bowditch. No. 2 Centennial, probably.

Mr. Parsons. When I was out West one of the things that attracted my attention was the sulky-plough. It worked very easily, and the farmers there seemed to do all kinds of work with it, and they recommended it very highly. We

have present with us this evening, Mr. Bodman, who own as large farm here, and also one at the West, and who runs several of those sulky-ploughs and several binders and seed-sowers. I would like to hear from him in regard to the practicability of those ploughs, and also of the binders, particularly for New England. I know of no binder in Massachusetts or in New England, except one that Mr. Stedman has purchased this year. I would like to know whether it is a practical thing, how many horses it requires to operate it, and also what its capacity is.

Mr. Luther Bodman of Northampton. I did not come here to occupy any time, nor with any preparation, and have had no idea of saying a word. I was raised on a hard, side-hill farm here, and the ideas that I got from farming here, I think have been quite useful in the West. We do not make much use of manure on the prairies. If we undertook to manure for wheat, oats or rye, we should get such a growth of straw that it would lodge and we should lose our manure, so manure is of but little value. But the inquiry has been made of me about these ploughs that have been spoken of. We use a plough made at Moline. Years ago we used a plough that did not run on wheels at all; but those have been discarded altogether. We now use a plough, the wheels of which, that were formerly made of wood, are made of iron. When the plough had wooden wheels, it would shift around so that it would not work well. Now the wheel is made of iron. It cuts sixteen inches, and is drawn by two horses, and will plough about three and a half acres a day; go right along and do the work nicely, and do it equally well on turf or on old land. We have one plough that we use when we want to turn under green crops. A very sharp roller runs on the beam, that cuts the stubble. I do not know why that could not be as well used here as there.

As to binders and reaping-machines, we use them there. I have run three this year. We use three horses abreast on them, or three mules. We cut from fifteen to twenty acres a day. The binder binds the grain up well. We use the cord, and use the wire also, in binding. But here I will say that I never saw one of those three machines run in my life. That may seem somewhat singular. You may say, "You are

talking about something that you don't know anything about;" but I know they work well; I know it saves us a great deal of money. I do not see why farmers could not use it here. We cut this year, upwards of eight hundred acres of wheat and oats with these machines.

QUESTION. Which do you like best, the wire or cord binders? What does it cost an acre to cut grain with one of those machines?

Mr. BODMAN. We use both. I can't tell you what it would cost for either of them. There is some objection to the wire on account of its getting into the grain. I think latterly we have been using the cord.

QUESTION. How many rows do you plant?

Mr. BODMAN. We plant two rows, and always ride on the machine. We plant from twelve to twenty acres a day, or the machine does, and covers the seed well. We have generally used the Brown planter in the West. The reapers we use are McCormick's. There are some three or four varieties of those reapers used in the West, and also of the ploughs that I speak of.

Mr. CHEEVER. I do not expect to unravel all this tangle that we seem to be in about the use of the swivel-plough, nor do I expect to convert by argument those who never could turn a good furrow with one, but if they will come to my place, I will show them that as good work can be done with a swivel as with a land-side plough.

To make a land-side plough take a wider or narrower furrow to accommodate a team that crowds towards or from the land, we have only to move the clevis a little. If using a swivel-plough behind a poorly trained team, the clevis would require moving at the end of each furrow, because if set to take a wider furrow going one way, it would take a narrower one after the mould-board had been reversed for the return furrow, so an even-walking and even-pulling team is indispensable for doing *perfect* work with ordinary swivel-ploughs, held by ordinary ploughmen. I have often heard men say of swivel-ploughs, that "they will turn a good furrow one way but not the other."

This may be owing to a defect in the plough, to a bent

cutter, or to a poor team, or the fault may be in the ploughman. Every ploughman has a new trade to learn when he takes a swivel-plough to hold, and some men are very slow to adapt themselves to new conditions. I have often driven three horses abreast for turning over green sward, using a 7A Matchless swivel-plough with a long three-horse whiffletree or evener. This whiffletree is attached to the plough by a draught-iron set one-third of the distance from one end, and to this short end the pair of horses, with their double tree are attached, while the third horse, with his single whiffletree, pulls from the long end.

Now, to show you how easy it sometimes is to have an object or an idea pass before one without being noticed, I will give you an illustration of what seemed to me like an extreme case of obtuse vision.

After ploughing awhile with three horses, and with my man to drive, I was called away, and wanted one horse to drive, so I left the pair at home, and told the man that he might use them ploughing old ground. When I returned at night, a neighbor told me that there had been a good deal of inelegant language used while I was away. I asked my ploughman what had been the trouble. He said that one of the horses had acted just as mean as a horse could act. She had not kept up within four feet of her mate, and whipping did no good; and the plough was as mean to hold as the team was to drive. I looked at his plough, and found that he had been using that three-horse whiffletree with the shortest end behind the smallest horse, and the long end hitched to the heavier one, so the light horse had just twice the work to do that her mate had. The land was all in ridges, for going one way the plough inclined to take a furrow about two feet wide, and returning, followed in the last furrow. I asked him why he used the three-horse whiffletree for two horses. He said because he could not find the other, and besides, he did not know why it should make much difference. The three-horse and the two-horse whiffletrees were attached when I left them, and he had himself taken them apart when he hitched up to do that ploughing, and yet he didn't know what ailed that plough and that team.

I give this as an extreme case; but I have found a good many farmers who appear sadly deficient in mechanical ingenuity when hitching to a plough, whether it be a swivel or a land-side.

Mr. Waterman. I would not have the impression go out that I cannot use a swivel-plough, for the first plough I ever held in my life was a swivel-plough. I think I can plough just as well as any man with a swivel-plough.

Mr. Cheever. If our speaker this evening could have pointed to a sulky-plough that would turn furrows both ways, I think he would have been glad to have emphasized the sulky-plough; but one objection to them is that we have to plough around our work with them, and leave dead furrows. Two sulky-ploughs have been constructed with the hope that they would plough back and forth, but neither of them has as yet been perfected.

Mr. Slade. Allow me to ask Mr. Cheever if he knows of any simple attachment that can be adjusted to a common plough, that will enable a man to turn under long rye or oats, or any heavy crop, and cover it up?

Mr. Cheever. I know of nothing better than a heavy chain hitched so that it will drag the crop down.

Mr. Slade. Where would you hitch it.

Mr. Cheever. Hitch one end to a cross-bar bolted to the forward end of the beam; the other somewhere near the rear end of the beam, letting it hang loose. I have had no practice with anything of the kind since I was a boy, but my father used a chain successfully.

Mr. Russell. I wish to add to this talk about ploughing, that the team is an important part in doing good work. I suppose that nearly everybody here has noticed the posters that have been put up in the hall by the direction of the old Massachusetts Society for the Promotion of Agriculture, who announce not only the importation of their Percheron horses for the improvement of teams in Massachusetts, but also the liberal premiums that they have offered for the produce of those horses as yearlings, which will probably be awarded year after next. I hope that everybody here has taken notice of these posters, and that the information will

be spread throughout the Commonwealth, and that the enterprise and the desire to improve our agriculture, which have characterized that venerable society for nearly a century, will be seconded by the farmers of Massachusetts.

I have never been heard, I believe, to advocate horse-breeding by our farmers as a matter of profit. I have been a breeder myself, but I have always doubted whether we could breed horses with profit, while we could get them so easily from the West; but of course all my opinions have to be pretty rapidly modified in these days. I have seen this last year an increase in the price of horses that seriously menaces the economy that we have lately enjoyed in buying horses from the West. Heavy horses, especially, are getting very high in price, and we, perhaps, may be able, with the assistance of the Society for the Promotion of Agriculture, to breed horses with profit. These horses that they have imported, are the very best draught-horses known; they have no peers in that respect. They are the farmers' best companion where they have been raised for a thousand years, for it is the oldest breed of horses, I believe, except the Arab, antedating the English thoroughbred nearly eight hundred years; and they are of a type that perpetuates the very best possible qualities known to the equine race, — size, strength, vigor of constitution, docility, and that power which belongs to all antiquity of blood, of perpetuating its type when it is crossed upon an inferior stock.

These horses, as you will see by these bills, are pretty well distributed throughout the State. I wish that the old society had imported ten of them instead of five. I think they would have had full use in the Commonwealth. I think they only need to be seen to be appreciated. Their quick action, their extreme docility and domesticity, which they derive from their Arab origin, and the continual re-inforcements which they have had for the last two or three hundred years from imported Arab and English thoroughbred stock, by which their strength and power have been kept up; all these qualities make them an exceedingly desirable breed.

I was announced in the agricultural papers as on the pro-

gramme to give an address upon horse-breeding, but I do not intend to do it. I do not know how it could have got into print. I knew there would be no time for it, and to-morrow we have a very important paper, which Mr. Moore will announce, and it will be impossible, probably, for me to say any more upon this subject than I have said to-night. But I know that the suggestion is all that you want. I hope you will bear it in your minds, carry it to your neighbors, and make it a matter of common information.

The CHAIRMAN. The first matter on the programme for to-morrow, is a paper from Professor Sargent, on forest fires. It is a very important subject, upon which we may desire to take some action with a view to securing legislation upon it. This meeting will be adjourned to meet here to-morrow at half-past nine o'clock, as it may take considerable time to get through with the paper and the discussion upon it, and after that perhaps the Secretary will give you a lecture on the horse.

THIRD DAY.

The meeting was called to order at nine and one-half o'clock, Mr. AVERY P. SLADE of Somerset in the chair.

In the absence of Mr. SARGENT, the Secretary read his paper on forest fires.

FOREST FIRES.

BY PROF. C. S. SARGENT, BROOKLINE, MASS.

The necessity of devising methods for preventing the spread of forest fires cannot, with the growing demands of a larger population upon our forests, be longer safely neglected. The forest question has become a question of dollars and cents; we cannot longer afford to allow our forests to burn.

The proportion of actually productive forest to population is in New England already too low, and we have long imported most of our forest supplies from Canada, from the Western pineries, and from the South. The centre of lumber distribution has moved westward from New England to beyond the Hudson, and then to the shores of Lake Michigan.

The extent of the loss which the country experiences every year from the destruction of woodlands by fire is enormous, and could the actual amount of such losses be computed they would astonish even those most familiar with the condition of the American forests. The division of the tenth census which has been specially engaged during the past three years in studying the forests of the country, has endeavored to gather statistics of the extent and value of the forests burned during the year 1880. The results obtained from this investigation have not been published yet. The information is often vague and untrustworthy, and even after the most careful analysis is so liable to mislead that it will be safer, for the present at least, to use the results as a basis for general discussion, without drawing actual deductions so far as the whole country is concerned from statistical statements in which the danger of error is of necessity considerable. Enough, however, will be shown to indicate, with all due allowance for defective returns, that the extent of forest fires throughout the country is infinitely greater than has ever been seriously supposed.

In Massachusetts, to be sure, the amount of property destroyed in this manner is shown to be comparatively small, and it is fair to assume in a community like this that estimates are more carefully made and more accurately returned than in the thinly settled forest regions of the far Western States and Territories. And yet in Massachusetts, in the year 1880, according to these returns, 13,899 acres of woods were burned over, the loss been given at over one hundred thousand dollars. In Pennsylvania, where the value of forest property is more appreciated than in Massachusetts, and the lumbering interests are only second to those of Michigan, 685,738 acres of forest are repoited burned over during the year, with a loss of over three million dollars. It is not probable that these statements are exaggerated, and in the case of Pennsylvania they undoubtedly do not fully represent the actual loss from this cause. The returns show that 3,988 acres of the forest destroyed by fire during that year in Massachusetts were situated in Barnstable County; that Berkshire County lost 1,377 acres; that Hampshire lost 1,150; Essex, 1,780; while in Bristol, Dukes and Hamp-

den the loss was in each case below 1,000 acres, and that Franklin only suffered a loss of one hundred acres.

During the present year a great tract of tree-covered land, probably nearly 7,000 acres in extent, not very valuable forest to be sure, still of very great prospective value at least, was burned over in Barnstable County, and the average annual losses by forest fires in Massachusetts may probably be safely put down at some 10,000 acres. The loss is considerable, but hardly enough to cause any serious anxiety if it was confined to the actual destruction of the wood growing upon the land. But forest fires destroy not only the growing wood but the fertility of the soil itself and its capacity to produce valuable trees again; they destroy, moreover, the confidence of the community in the value and stability of forest property. The destruction by fire, then, of the wood standing upon a few thousand acres, more or less, does not by any means represent the entire or more than a small portion of the loss which forest fires entail upon the State.

Sufficient attention has not been paid to the effects of forest fires upon the soil and the subsequent growth of plants. We have been accustomed, in treating forest fires, too generally to consider the damage done to the growing wood alone, and have not considered the much greater loss the land itself suffers from being burned over. If only a portion of the trees growing on a tract of land are cut, a sufficient number being left to protect the soil and produce a supply of seed,—if these are guarded from fire and browsing animals which, next to fire, are the most active and destructive enemies of the forest, the same species will continue to grow almost indefinitely and a constant succession of young trees will regularly spring up to replace those which have been removed. This is a system of forest management very often adopted, especially with certain varieties of trees, where scientific forest management prevails; and it is on many accounts a very sensible and economical method, although, of course, susceptible of very considerable modifications to meet peculiar cases of forest growth or climatic conditions. If, on the other hand, a forest is destroyed by fire which kills the trees and undergrowth of shrubs and herbs, the same species, except in the case of some of our

least valuable trees, rarely spring up again. Let us take the case of a White Pine forest, because the White Pine is probably the most valuable forest tree to-day in New England and because we are all familiar with its habits of growth. If a forest of White Pine is destroyed by fire this tree does not spring up again. The land which, if only a part of the trees had been cut, would have continued to produce pines indefinitely, is not covered again with any growth of trees for a considerable period. The fire-weed first makes its appearance. The light seed of this plant is often blown for a long distance, and falling upon the bare ground germinates quickly, and finally covers the burned surface with vegetation. Birds drop the seeds of raspberries and blackberries, which find sufficient nourishment and light for germination. These, as they grow, cover the ground, and afford protection to the stones of the little mountain cherry, dropped by birds also, or the light seeds of the Gray Birch, or some of the Willows or Poplars, which are constantly blowing about, and which will germinate anywhere upon unshaded ground, however barren.

These are generally the first trees which succeed a White-Pine forest destroyed by fire; but years often elapse before the ground is covered even with such trees. Nature works slowly, and the wounds made by fire on the earth's covering of trees are only healed under the most favorable conditions through the gradual growth and decay of many generations of plants. The Cherries and the Birch and Poplars are short lived, and unless burned up, when the same process of recovering the soil commences again, are succeeded by more valuable broad-leaved trees. Squirrels and other animals deposit acorns and nuts in the ground, and the wind brings the seeds of Maples, Ashes, and the valuable Birches. Such seeds find protection among the Poplars and Willows which had sprung up on the burned land, and as these die, the more valuable trees get a chance to grow and gradually occupy the ground. This new forest of hard-wood trees, if protected from fire, will long occupy the ground, and the original Pine forest will not appear again until the land, long enriched by an annual deposit of leaves, has been again stripped of its tree-covering, and mellowed by years of cultivation. Such

land nearly all over New England, if freed from the plough and the scythe, and guarded from fire and pasturage, grows up again with Pine. The different processes, however, by which White-Pine land, on which the forest has been destroyed by fire, has been again brought into the condition to produce spontaneously another crop of Pine, have occupied a long period of time, — so long, indeed, that it must extend through generations of human life. The forest fire, then, which destroyed the Pine trees growing upon the land, destroyed, also, the capacity of the land to produce again, during a period which may be set down at from fifty to one hundred years, a similar crop of trees. The damage inflicted upon the land by forest fires is, of course, not irreparable in a climate like that of New England, where the annual rain-fall is sufficient to always ensure a growth of trees of some sort, if the ground is left entirely undisturbed, and sooner or later, in the ordinary workings of nature's laws, forests will succeed each other here. But in some parts of the country where the rain-fall is so slight that there is a constant and severe struggle between the forest and the plain, and where trees under the most favorable conditions barely exist, a forest fire not only kills the forest but it makes any future growth of trees impossible.

We, in New England, are more fortunate, and it is entirely within our power to regulate the composition of our forests, and maintain a proper proportion between forest areas and farming land.

If, however, forests are subject to constant and unnecessary danger of destruction by fire, there can be no proper system of forest management introduced into the usual economy of the community. There is little inducement to plant a forest, or protect and encourage the growth of natural woodlands, so long as the condition of public sentiment is such that the authors of forest fires are not held responsible for their acts. A man cannot be expected to expend money or labor on his trees, or allow them to grow a year after he can find any market for them, if he has the danger of forest fires constantly before his eyes. There is no inducement, under these circumstances, to allow a forest to mature for timber; it is safer to cut it off for cord-wood at the earliest

possible moment, and thus reduce the risk of probable loss by fire.

Under these circumstances it is useless to adopt any of the methods of thinning or pruning by which the value of young forest trees for timber may be vastly improved, or to guard the woods from roaming and destructive cattle; and it follows that a large portion of the profits which our forests could be made to yield, under a different policy, are lost.

The forest fires, then, destroy the trees. They destroy the capacity of the land to produce again during long years similar trees; and, finally, they so shake the public confidence in the permanent value of forest property that, even in a State like Massachusetts from which the original forest has long disappeared, and where the value of all forest products is enormously high, capital will not engage in forest production, which, with the condition of our forests, could certainly be made enormously profitable, until the risks from fire are reduced to a minimum. This is a matter of special interest to New England to-day, because upon it largely depend the country's supply of White Pine, and the greatly enhanced value in the early future of much New England land.

Not a small part of central and southern New England, no longer profitable for agriculture, is now growing up with White Pine; and this White Pine, if it can only be protected, will, in a few years, it is safe to predict, exceed in value the net profit all the New England farms can produce during the next fifty years. In some parts of New England this second growth of Pine has been growing for a considerable time, and has already given rise to large and profitable industries. The value of logs cut in Massachusetts during the census year, reached nearly two million dollars; at least one-half were second-growth White Pine. More than one hundred million feet of second-growth White Pine were sawed during the same year in Vermont and New Hampshire, and nearly if not quite as much more in Maine. The manufacture of wooden ware, an important and growing Massachusetts industry depending upon this second-growth Pine, has made Winchendon, Worcester County, the great centre of this business in the United States, if not in the

world. These young forests of Pine are already, then, of great value to New England; at no very distant day, they must become one of the most important factors in its prosperity. The problem growing out of the actual condition of the country's supply of White Pine, and the effects which any serious diminution of this supply must have upon our prosperity as a nation, need not be considered here at any great length.

The entire supply of White Pine growing in the United States and ready for the axe does not to-day greatly, if at all, exceed eighty billion feet, and this estimate includes small and inferior trees, which, a few years ago, would not have been considered at all in making such an estimate.

The annual production of White-Pine lumber is not now far from ten billion feet, and the demand is constantly and rapidly increasing. The publication of these facts a few months ago has greatly increased, and in some cases more than doubled, the value of Pine lands in parts of the country; and it does not require any particular powers of foresight to be able to predict that the price of White Pine must advance to still higher figures. Enough is now known of our forests to permit the positive statement that no great unexplored body of this Pine remains; and that, with the exception of the narrow Redwood belt of the California coast, no North American forest can yield in quantity, any substitute for White Pine, the most generally valuable, and most generally used of American lumber. Under these circumstances, the growing Pine of New England will soon become an important element in the country's supply. In no other section is there so much young Pine growing; and if we cannot compete with the West or the South in the production of cereals and wheat, we have at least in our favor, soil and climate better suited to grow Pine than any other part of the country. New England cannot allow this opportunity for increased prosperity to be lost. The demand for White Pine is rapidly increasing; the extent of the supply is at last known; no available substitute exists to any great extent; we possess already a considerable quantity of young Pine, and greater natural advantages than other parts of the country for growing a

much larger amount. A market is assured for all that can be produced, and we may look forward with certainty to obtaining prices for Pine, which promise, if we can judge the future by the past, to make the value of land covered with thrifty growing Pine, much greater than that which can ever be obtained for the best agricultural land in the State.

The single danger which threatens property of this nature, is the danger, real or imaginary, of destruction by forest fires. If this danger, and the dread of it, could be removed, or at least greatly reduced, an investment in young Pine growing, in New England, would promise to capital, in the long run, larger returns than could be derived from almost any other legitimate business enterprise; but so long as this dread of fire exists, capital will naturally content itself with smaller and more certain returns. If under these circumstances it is desirable to foster and develop the growth of New England forests, better legislation than now exists for their protection must be secured; and then the public mind must be educated to the importance of forest protection, that the enforcement of such laws as may appear necessary for this purpose may be possible.

Legislation in advance of public sentiment cannot be expected to accomplish any very marked results; and unless we can learn to appreciate the rapidly increasing value of our woods in their commercial aspect, the passage of laws, however carefully prepared, will not avail a great deal. But to return to the immediate question of forest fires in Massachusetts. The census investigation showed that during the year 1880, fifty-two such fires were set by sparks from locomotives; that forty spread from carelessly burned brush-heaps; that hunters caused thirty-seven; that nineteen careless smokers dropped their lighted cigars or burning ashes from their pipes and so caused disastrous conflagrations. In three instances the origin of forest fires is ascribed to the burning of charcoal, and in only eight cases to malice. It appears, then, that the railroads are responsible for the greatest number of these fires; and that the remainder may be generally traced to sheer carelessness. The railroads are already held responsible for the actual damage they inflict upon property in this way;

but, as has been shown, the destruction of trees is only a small part of the real damage caused by forest fires. Still the railroads cannot be held responsible under the law for the prospective damage represented by a partial or entire destruction of the plant-producing capacity of soil which they have burned; nor can they well be made to pay for the loss of confidence in forest property which such fires cause. Such damages can neither be estimated nor collected. Fires set by locomotives can, however, be largely prevented by the general adoption of some effectual spark-arrester.

It is true that such a contrivance has not yet been perfected to the entire satisfaction of railroad experts; but if the railroads were compelled to adopt some of the existing patents, American ingenuity and mechanical skill can be depended on to perfect them.

It is a case where supply will quickly follow the demand. As a first step, then, towards checking the spread of forest fires, the legislature should compel all railroad corporations operating within the State, to provide their locomotives with spark-consumers. Such appliances are in general use in Europe, and locomotives should not be longer operated without them in this State.

One of the principal dangers to the forest, and more especially to the coniferous forest, which we in Massachusetts, when we increase our lumbering operations, shall soon learn to dread more generally than at present, comes from the custom of leaving scattered about the ground, the tops and branches of the trees cut down during the winter. This debris becomes, by the middle of the following summer, as dry as tinder, and furnishes the very best material to feed a fire started in the woods. Any enactment intended to prevent forest fires should contain a provision compelling, under penalty of fine, the collection and careful burning during the winter in which the trees are cut, of all parts of them not actually carried from the ground. The possibility of successfully dealing with persons carelessly setting fire to forests, is more difficult and more remote. Such persons rarely confess their carelessness, and still find protection in public indifference.

But until public sentiment makes it possible to convict a person setting carelessly or wantonly a forest fire, and to

hold him responsible under the law for the damage he inflicts, the solution of these questions will not be very near. The following was passed by the last legislature: —

AN ACT for the Protection of Forests against Fires.

Whoever wantonly and recklessly sets fire to any material which causes the destruction or injury of any growing or standing wood of another, shall be punished by fine not exceeding one hundred dollars, or by imprisonment in the county jail not exceeding six months.

The passage of such a bill, defective as it is, indicates at least a feeling that at last the forests of Massachusetts should be protected. The law, as it now stands upon the statute book, should, however, be amended. It is not comprehensive enough, and it is not severe enough. It would not be very difficult to draft a bill to cover the necessities of the case if the feelings of the community in regard to the value of forest property were more advanced; but with the existing apathy in regard to the subject, and the impossibility of securing now, without a full discussion by the press and the people of the forest question, the enforcement of any proper law upon the subject, it seems better to present the subject thus generally for your discussion and consideration, without attempting to sketch even the form of such a bill as seems necessary to afford Massachusetts protection from forest fires. The better understanding of the forest question as it exists in New England to-day which must follow any discussion of this subject, is the best guarantee that our forests will in time be protected, and that they will receive the care and attention which in their present economic aspect, if in no other, they deserve at our hands.

I commend the subject to the most careful consideration of the press and the farmers of New England.

QUESTION. Did you ever know a case where a pine forest that had been cut off, whether the brush was burned or not, grew up to pine again?

Mr. RUSSELL. I never did.

Mr. ———. I understood the essay to say, or I infer from the essay, that if the land was not burned over, it would grow up to pine again. Now, I never knew a case where a pine forest came up again.

Mr. Russell. I think if you will read this lecture over carefully when it is printed, you will see that it states that the effect of burning it off prevents the production of the pine for a much greater length of time than if it was merely cut off. Mr. Sargent says in this paper that, in the ordinary course of nature, the pine will appear in from fifty to one hundred years.

Question. On the same ground?

Mr. Russell. On the same ground if it is burned over. The crops that come in the meantime are, first, fire-weed. That covers the denuded land with vegetation, and enables it to take up the seeds that are dropped by the birds: first, of the briers; next, of the cherry and similar trees; then the larch, birch, and other inferior trees, which in time are followed by those trees that come from the seeds brought by squirrels, and the maple seeds that are blown by the wind; and, in the course of time, the white pine will again appear; that process being, as I understand from this paper, much slower than if we cut it off in the ordinary course.

Mr. Jewett of Pelham. If I understand the law correctly, it provides for the punishment of persons who wantonly or maliciously set forest fires. The fire that burned about two hundred acres in our town last year was caused, not wantonly, but by smoking out bees. I do not think the men intended to burn the forest, and they supposed they put the fire out. Such fires are often caused by hunters smoking out squirrels. They are not set maliciously or wantonly.

Mr. Russell. The words of the statute are "wantonly and recklessly."

Mr. A. A. Smith. I believe it is considered a law of nature that the same species of trees will not follow; but before we criticise a valuable paper, I think we shall find, if we examine it closely, that the writer did not use the language that, if the pines should be cut off and the land burned over, the same kind of trees would come up, but he said if the pine should be partially cut off, trees of the same kind would come up again. I understood it so.

Mr. Shepard. I think that is a fact. The second growth of pine that is used so much in the manufacture of wooden ware are trees that grow up in old pastures. Many of them

spring up around, and are cut off as fast as they get large enough to use, and they grow very luxuriantly. I recollect going, some years ago, to a forest that had been used as a family wood-lot, and was cut into every year, and the pines and oaks there were the second growth.

There is one point suggested by the essayist which would seem to be quite a tax upon a person cutting off wood; that is, that he should be obliged to burn up the brush. Now, perhaps it would cost five cents a cord more to pay a man to pile up his brush in winrows. He has got to handle most of the brush to get it out of his way, and to put it in winrows would not be any great hardship.

I have a case in mind where a lot within a mile of me is being cut off this winter. It is covered with chestnut, which was sold for a hundred dollars an acre, and the man has been offered four hundred dollars for his bargain. Three French Canadians are cutting that off, and for their own convenience in hauling, they are piling the brush in winrows; of course it is more convenient for those who draw the wood off.

Mr. Manning. I do not understand that the same kind of forest may not be continuėd for any length of time, if the trees are thinned out, and the smaller ones allowed to grow; under such circumstances, the same kind of wood will continue for a long time. Frequently, after a growth of pine is cut off, fire burns over the ground, destroying all small evergreens, and if anything comes up, it is the small deciduous trees that were under the pines, but not very conspicuous until the pines were taken away. If pines do come up, it will be because there are seed-bearing trees near by. I have seen a case where the fire killed every tree in a certain section excepting a few seed-bearing trees a little higher up on a hill; and yet, in not more than five years, the land was coming up with a new growth of pines, from seed wafted by the wind from the few remaining trees. If these trees had not been there, there would not have been another growth for many years.

The injury to the land and to growing trees of any kind, where fire has burned, is very great. The injury is much greater where the land is dry and rocky than on fertile land and deep soil. Many fires come from locomotives on the

railroads, a great many from carelessness, and some from maliciousness. I was at Montreal last August, at the meeting of the American Forestry Congress, where there were gentlemen from various parts of the United States and Canada (the organization including members from Canada as well as the United States); a great many essays were read, and a great many things said, by men who had ample opportunities for observation in regard to this matter. There was one man who said he was cutting lumber near the head-waters of the Ottawa River, near the divide or water-shed between the St. Lawrence and Hudson Bay basins. He was operating on a tract of land fifty miles square. He pays a royalty or stumpage to the government. He said this tribute to the government was a source of revenue of millions of dollars, in the aggregate on all the forest lands which were called the Crown lands. He said that he was satisfied that the loss caused by the destruction of timber by fire in Canada was ten times more than the loss by the legitimate cutting of timber. He said: "There is no comparison; we cannot tell the extent of the destruction by fire."

This is not a new thing. Before lumber had any value, fires swept through the country, and destroyed immense tracts of forest. In 1880, I was among the Rocky Mountains in Colorado, at the same time Mr. Sargent was there, although not in his party. He made extensive surveys, that, no doubt led to the ideas presented in his paper. At some points, as far as the eye could distinguish anything, nine-tenths of the forest had been burned over within comparatively few years. There were some dead standing trees, and much fallen timber, but generally nothing but rocks remained, where it did not seem that trees could grow again. But nature is persevering, and young pines and spruce were again covering the rocks. I was on the eastern side of the Rocky Mountains, and, in company with others, ascended Pike's Peak, which is 14,345 feet high, — more than 8,000 feet higher than Mt. Washington in New Hampshire. Timber grows up these mountain slopes more than 12,000 feet above the sea-level. We passed through miles of timber that fire had been through within a few

years. Some of those trees were three feet in diameter. Above the fire line, we saw trees, at 11,000 feet elevation, sixty feet tall. Some of these trees were limbed to the very ground, and evidently stood alone for generations, for they had a very wide spread of the lower branches, now dead; but as other trees grew up about them, the tops shot up as high as the more slender trees all about. Where the ground had been burned over, there really was no soil left. The fire had burned up all the moss and leaves, and what seemed to be the soil that the tree grew in was literally all rocks; there was not a shovelful of earth left after the fire. Each time the soil is burned away, the fire pulverizes the rocks more or less, the rains and winds carry it away; and yet, in spite of all that, evergreen trees from seed were there and of all sizes, six inches to ten feet high, and in time will attain some dimensions, if fire is kept out. On lower ground, you find where some of those finer particles of rock have collected, and there the trees will grow with much vigor.

Rabbits and deer gnaw the trees, and do great damage to the forest growth. They eat off the new growth of many deciduous trees, and keep them small and stunted. I do not know that any estimate has been made of the amount of injury done by animals. But fire is the worst enemy of forests. The most of the Rocky Mountain forests are quite inaccessible for commercial purposes, but serve well to show the disastrous effects of fire.

The white pine, as has been said here, is, without any doubt, the most valuable tree we have in Massachusetts. It is easily grown from the seed, and easily transplanted. I had, some years ago, two thousand transplanted, from five to eight inches high. I ordered a ball of earth, two to three inches square, taken up with each one. They came out of pasture land which was rather moist, but not wet, and free from rocks. Out of those two thousand trees, I don't think I lost one hundred in transplanting. If they had been pulled up with no earth adhering, not many could have been saved.

QUESTION. At what time of the year were they moved?

Mr. MANNING. It was in May. This last winter, about

this time, one man and two of my sons went into the forest and dug out about three thousand trees. A large number were put into nursery rows, and covered up with boughs, until into the spring, and, as far as they were well covered, they are living, but as far as they were exposed to the winter and spring sun and winds, they are about all dead. I think these facts prove that transplanting can be applied to renew our forests, and that trees may be taken from their native growths; but it is doubtless better, in most cases, to make a young plantation with nursery trees.

John A. Hall of Raynham, set out many acres with white-pine trees, planting them ten feet each way. In my native town, Bedford, N. H., I remember a white pine that grew from seed, in forty or forty-two years, to be two and a half feet in diameter. There was nearly a cord of wood in the body and limbs. If that can be done in forty years it is worth trying for, and I believe it should be the determination of every farmer to plant from a few hundred to a few thousand trees as regularly as he plants his farm crops. The danger of his pine forest being injured by fire is something of a drawback, but he can manage the fires, generally. We need a better public sentiment to encourage forest planting to keep up our forest growth. It is not popular enough to plant forest trees yet. There is no fear about the sale of white pine. It is especially in demand, and always likely to be. I can remember white-pine pastures where there were only a few small trees, which are now, with their good-sized trees, the most available part of the farm to raise money on. The wooden-ware manufacturers at Winchendon and vicinity are seeking such timber, buying whole farms where white pine abounds, and working it up. They are constantly looking out for white-pine lumber. Even small sapling pines, six inches in diameter, are in demand.

The matter of forest fires is a difficult subject to deal with. You do not have the sympathy of the surrounding people in trying to get any redress when fires have occurred, and it is very difficult to get proof that will answer the law, or courts to convict the incendiary.

Mr. Cheever. How old were those little white pines, of which you transplanted about two thousand?

Mr. MANNING. They were four or five years old from the seed. White pines do not bear seed every year,—not more than once in three or four years. I wish I could be a little more definite about that. I remember that fifty years ago my grandfather, who was famous for catching pigeons, used to say they were more abundant certain years than others, and that was when the white pine bore seeds, once in four years. I expect a large crop of seed next year. Last year there were none, in my observation; the year before, none. On my way from the West, in 1880, along the north shores of Lakes Superior and Huron, down the St. Lawrence and along the western shore of Lake Champlain, and all the way home to Boston, I did not see a single cone of the white pine.

Mr. JEWETT. I would like to state one item as the result of my own experience in regard to the damage caused by forest fires in Massachusetts. Thirty-eight years ago I cleared off a lot of heavy oak, pine and chestnut timber on land that produced from fifty to seventy cords to the acre. This winter, on cutting the same lot again, I found that until I got to a certain point about half-way across the lot, the trees that had been growing thirty-eight years — almost entirely chestnut — were very tall, straight, handsome tie trees, worth, perhaps, a hundred dollars an acre; but when I got to that point I found the effects of a fire which ran over half of the lot after the trees had been growing from five to ten years, when the sprouts and young trees were from ten to twenty feet in height, if I remember right. The effect of that fire has been to cause the wood on that part through which the fire ran to be worth not more than twenty-five dollars per acre to-day; whereas the tie-timber part that was not burned is worth, perhaps, a hundred dollars per acre. That fire ran miles and miles over a large tract of our hilly, moist land, which grows chestnut very rapidly. I think the previous growth was mostly pine and oak, some large chestnut trees, but no sprouts amongst the large growth. This fact of the reduction of the value of that land seventy-five per cent. where the fire ran for miles and miles over a large extent of hill country, is an item that may be of value in this discussion.

Mr. Slade. In relation to the experiment mentioned by Mr. Manning, that was tried in Raynham by Mr. John A. Hall, I happen to know something about that. I am not particularly familiar with the plantation that Mr. Hall made, but I am familiar with one that another man set out in consequence of Mr. Hall's experiment. It was set out in 1840. I saw it in 1844, and in 1874 I saw it again, went over it, and it was certainly a remarkable production. The trees were very tall. They were set six by ten feet apart, if I recollect rightly. The gentleman had an offer for it then which people advised him to take. The owner of a box-factory had been trying to get it. I think he was offered something like five hundred dollars for it at that time. The last I knew of it, which was a year or two ago, he was offered seven hundred and fifty dollars for it. I have not seen the trees since 1874. I think then they would average fourteen inches in diameter. They were tall and straight; they had been kept trimmed pretty well. And here I want to say that, to my positive knowledge, the land that those trees were planted on was not worth six and a quarter cents an acre to cultivate. It was so poor that a weed would not grow on it; but still that crop of wood has been produced upon it. In consequence of the success of that experiment there have been hundreds — and I don't know but thousands — of acres planted to white pine. The piece to which I refer was planted by Mr. Hall on a contract at six dollars an acre.

Mr. Hersey. The other day I had the curiosity to measure a pine tree which was set out twenty-seven or twenty-eight years ago. The tree when set out was not more than six inches high, and it girths to-day, one foot from the ground, four feet two inches and a half. That was the largest tree of quite a number of trees which were set out at that time. But all of them, I think, will girth over three feet. The man who set out those trees was over sixty years of age at the time, and yet he lived to see them girth—one of them, at least—over four feet. He lived to a good old age, it is true.

Mr. Myrick. If any of the gentlemen have visited the Enfield Shakers, they have seen one of the best examples of white pine planting that there is to be found in New Eng-

land. There is a great deal of this light plain land there, which is of very little value. One of the centre family of Shakers has experimented for a great many years on those plains with white-pine seed. He gets the seed by going to some old white-pine trees and picking up the cones in a wagon and carrying them to the barn, or some shed, and there he lets them dry. In the winter he husks them out with a rake. His long experience has shown him that the best way to plant the seed is merely to strew it right over the ground. He has tried transplanting a great many years, and he has finally concluded that no matter what the nature of the soil is, whether a sandy plain or a rocky hill, the way is to strew the seed on top of the ground: there are places on those sandy plains where he planted the seed in that way years ago, where the trees are now quite large. A few years after the first planting, he planted others, which are also growing, and so on down to within a few years. In another, on top of a hill, where the soil is hard and rocky, and the field is full of every kind of tough grass and small briers, he put the seed on in the same way. There is now a growth of trees there from two to three feet high.

Mr. ———. I beg your indulgence, Mr. Chairman, and the indulgence of this audience for a moment. I have suffered some loss myself from forest fires. Some fifteen years ago I had fifty acres burned over, and also the fence on three sides of it. It has not recovered to this day. I have never received any remuneration for that loss and never expect to. It not only spoiled the woodland, but the pasture. It has grown up within a few years to poplar, and has almost become a forest. They are now using poplar for making paper, and perhaps some one who lives after I am dead may find a profit from cutting those poplars.

Now, in regard to the same wood coming up on the same ground, I have had a little experience in that. When I was a boy, perhaps twelve or fifteen years old, I helped my father cut off from a piece of land a lot of beech. That was the wood that was on the piece. Immediately there sprung up what we call dog cherry—a complete swamp. I never saw the like. Those poles grew up thirty, thirty-five or forty feet, and we cut them down for fencing-poles. As

soon as that crop was taken off, another crop sprung up of rock maple, which is a beautiful lot to-day. I am a little over sixty years old, and within my memory there have been three distinct species of wood grown upon that soil. First, beech; second, dog cherry; and now, maple almost big enough to tap for sugar.

Now, to go back to the forest fires. If some way can be devised to make people who are malicious or careless enough (whether wantonly careless or not) to cause a fire in the woods, responsible for those fires, by any law passed by our legislature, I for one shall raise my hand for such a law to be passed to make those setting fires, whether carelessly or maliciously, accountable for the damage.

Mr. Stedman. I live in a section where we suffer very materially from forest fires, and where the difficulty is increasing year by year. In the town of Chicopee are two large manufacturing villages in which are many people not fully employed, perhaps, or boys who go into the woods chestnutting in the fall of the year, or hunting, and without any purpose on their part fires are set. I know that they have been set apparently for the purpose of clearing the way for the finding of chestnuts, by carelessness in the use of firearms, and sometimes, we have reason to think, just for the sport of seeing the fire. One of those two villages has a section of plain land, which is covered with trees of fifteen, twenty or twenty-five years' growth, twenty and thirty feet high. Last spring I had a wood-lot of thirty acres of this kind of timber burned over completely. Now, how are we to get at the remedy, I do not know. It would seem that there is nothing to be done but to set a watch.

If Mr. Myrick will allow me, I will make a little correction of one statement that he made. It was Omer Field, of the north family of Shakers, who set out the trees of which he spoke, and there are acres of that white-pine lumber growing which has been raised much cheaper than our friend (Mr. Manning) spoke of from the eastern part of the State. They simply gathered the seeds and sowed them on this almost worthless land. Instead of being six feet apart, there is such a forest that you can hardly walk through unless you hold on to your hat, and almost your head. They

are of different ages, from twenty years' growth down to very small trees, and a success in every instance.

Mr. A. A. SMITH, of Coleraine. As our time is somewhat limited, I move that we dispense with the further discussion of this subject and ask our Secretary to speak upon the breeding of the horse.

Capt. MOORE. I trust that will not be done until this discussion has gone further. I think this is a very important matter. I hope the gentleman will withdraw that motion.

Mr. RUSSELL. This matter has been brought before the meeting at the motion of the State Board, and the Board requested Mr. Sargent to prepare this paper. There is no more important topic before the people of Massachusetts than this matter of forestry. It is important to the people of the whole country, and we in Massachusetts, in such matters as this, ought to take the lead. As Mr. Moore has said, I trust that it will not be dismissed without a very full discussion, if it takes up to the very last moment. I will say here, what I might say as a prelude to any horse talk, that the least important matter which the farmers of Massachusetts have to deal with is breeding horses.

Mr. SMITH. I will withdraw the motion.

Mr. SLADE. I would make a suggestion. We have heard considerable about losses by forest fires; now, what we want to get at is some method of preventing them. I hope some one will suggest preventive measures, and if no one else desires to speak, I will call on Mr. Moore.

Mr. MOORE. I do not know that I have any preventive measures to suggest. I think that the paper which has been read is important enough to be discussed in all its bearings, because, if there are any errors in it, we want to have them set right; otherwise, if the matter goes before the legislature, a committee of the legislature who do not know as much about this matter as the farmers here, or Professor Sargent, might adopt some erroneous notions. I think one thing suggested in that paper would be absurd. Professor Sargent suggests that, in cutting off the wood, the owner should be obliged to collect the brush and burn it. Well, what is the reason? Because it becomes dry and burns like tinder if fire gets into it. That is all true, if fire gets into

it, but we want to stop fire getting into it, and then why should we destroy that brush? It acts on the soil as a mulch. It protects the young trees that are coming up, and in the course of time decomposition takes place, and then it is a benefit to the soil. There is an absurdity to me in that proposition. As I said before, I should have to think a good while of this before I could suggest a proper remedy; but that there can be a remedy, or a partial remedy, seems plain. It is an important subject, and one of the most important that we could discuss.

I understood that paper precisely as my friend Mr. Smith understood it in regard to the pine — that a gradual removal of the forest did not destroy the growth of pine. I know it is so. If you go into a pine forest you will find the young pines growing up all around. If you do not remove all the trees at once, you do not destroy it so but what the seeds of the old pines will renew that forest, which is the profitable growth. I should disagree with Mr. Manning in regard to the seeding of the pine. Mr. Manning told you a few moments ago that there had been but very little pine seed for some years. I never saw the white pines covered with such an abundance of cones as they were a year ago last August or September, so that some of the trees were brown with the cones. But what he says in regard to the white pine seeding is true in a measure; it does not produce that large crop of cones every year. Then, again, if you want to grow a pine forest, undoubtedly the most feasible way is to sow the seed, but it is not an expensive way to transplant. You need not put the young trees into nursery rows. Any of you living in any town about here where white pine grows, can find plenty of pastures where you will see seedling pines coming up, if there is a pine forest near; and if you do not want to have the white pine take possession of the land, you can take those white pines, all the way from eight inches to three feet high, and by cutting a little circle around the trees, you can put in a spade, raise them up, and carry them off, being very careful to protect the root, which is very sensitive to air and heat. Remove them in a dull day and keep them from the sun, and you will not lose more than three per cent. of them if they are

set out in a mere sand-bank, any time in May. I would say that I would like to plant them just as the buds were swelling, or perhaps open, but not having made much growth. I planted last year some five hundred or a thousand of those pines to cover up some barren spots near my place; one of them, a spot above my corn-house, where it is nothing but sand. Hardly one of those pines has died; they have gone through this summer, the driest summer I ever saw, without apparent injury. Of course they were planted a year ago this spring. There is no difficulty in transplanting pines.

Ralph Waldo Emerson, who lived near my house, who died this last year, had a piece of white pines, of about four or five acres, that he gave some twenty-five years ago to Henry D. Thoreau, of whom you have all heard as being a very singular man (I suppose if he had lived at the present day they would have called him a philosopher), who lived as a hermit on the banks of Walden Pond, to plant white beans. Thoreau, to illustrate how cheaply a man could live, undertook to live on the white beans that he grew on that land that would not grow anything but white pines. Fire has run through that grove of white pine; still, there is a thick growth of pines, and there are plenty of pines more than one foot through to-day.

Then, so far as forest planting is concerned, it would be very interesting to any gentlemen who happened to be in the eastern part of the State to go down near Lynn to visit a place formerly owned by Richard S. Fay, and perhaps in the family now. There are more than a hundred acres, covered with a growth of American and European trees, many of them trees which Mr. Fay planted within forty or fifty years, and, as Mr. Bowditch informs me they have sold a good many thousand dollars' worth of that wood.

The subject before this meeting is not so much tree-growing as the protection of our present forests from fire. I do not know what action this meeting desires to take upon that. I have no plan to suggest. Some gentlemen may have a plan, Mr. President, and therefore I will not occupy your time further.

Mr. Manning. I should begin to plant the trees as soon as frost was out of the ground, and I should continue it into

June, or until they had begun to make some growth, but they must not be frozen or dried; out of the ground a very slight exposure to our hot, drying winds is fatal to evergreens. I do not say that it is necessary to put the trees into nursery rows, but I spoke of the fact that I had done so; and I believe in transplanting trees from the seedling beds before planting in the forests. Every farmer can frequently find the material on his farm, or in the immediate vicinity of it, to transplant hundreds and thousands of trees, from year to year, and have his farm keep up its growth of wood. Instead of having old pastures, hardly worth turning cattle upon, he may have trees growing there that in twenty or thirty years will be worth twenty times what the pasture is for grazing. I have seen timber that was worth two or three hundred dollars an acre growing on land that, without the trees, would not have been worth five dollars an acre.

I would not confine my remarks to white pine. White ash is a good tree in some soils, and the maple, white oak and red oak, also. Out here in the street is a rock maple tree eleven feet and six inches in circumference; somebody living remembers when it was planted. The silver maple will make more wood in a given number of years than any other tree. The Scotch larch is a good tree to plant; it can be transplanted easily, and will grow well. Part of the trees upon Mr. R. S. Fay's place at Lynn were Scotch larches, some of which they have cut down for telegraph poles recently. I was there and saw Mr. Fay in 1857, when the trees were twenty feet high; he planted his forest eight years before, with larches and various other kinds. I did not go there again until 1879, when I saw young Mr. Fay, and some of the trees that I saw there in 1857, twenty-two years before, that were then three or four inches through and ten to twenty feet high, were two feet in diameter.

The only partial remedy I know for forest fires is to keep out the undergrowth, and thin out the trees. Then, if a fire gets into the forest, it will not kill many of them; but if you leave the trees to grow up thickly, and let the undergrowth remain, a fire will have a much more deadly effect.

Mr. Shepard. We have other forest trees that are perhaps quite as valuable as pines in certain sections and that

are not half as much exposed to fire as the pine. One of them is the chestnut. The chestnut is a very valuable tree, especially now, when there are so many railroads in operation; and my impression is that in many instances fire does not kill the roots of the chestnut, and it springs up again. Then the leaves of the chestnut are soon out of the way, and a fire does not run over them readily. The value of that tree is hardly sufficiently estimated. A chestnut tree will grow in twenty-five years so as to produce ties. If you cut down a chestnut tree, another growth immediately springs from those roots, and you have got another forest growing right off, and every year or two you can cut off quite a crop of chestnut ties, which are always in demand.

I will mention another thing, and that is, if you cut down a chestnut tree for wood, it is hardly fit for fuel the first year. If you sell a man a load of chestnut wood in summer that was cut the winter before, it is the last load you will ever sell him.

Mr. Grinnell. I think this discussion has gone as far as is profitable without any direct action. I had, if you will allow me to say so, a little experience in the legislature of last year, having prepared the law now on the statute book, which was all we could get at the time. The law had before provided against the malicious firing of forests, or the setting of fires maliciously that might run on to other land, and the addition was the best we could do, but possibly something may be done this coming year, and I am happy to say that we have here among us, as the senator from this district, one of the most intelligent farmers in this part of the State, who will accomplish as much as any one can. I therefore move that the Board of Agriculture be requested, by this meeting, to bring the question of protection of forests against fires before the legislature as early in the coming session as practicable.

This motion was carried unanimously.

The Secretary of the Board was then called upon to address the convention on the breeding of horses, and responded as follows:

Gentlemen, there is but a very short time to discuss this question. I expect to take the train in half an hour, and I

hope that anybody present who has questions to ask will have no hesitation in interrupting me at any moment.

As users of horses — *users-up* of horses, I might perhaps say — there are no people in the world more extravagant than the people of Massachusetts. We import into this State a very great number from the West, and owing to the improvements in agricultural machinery, we are compelled to employ them upon the farm in the place of the patient ox that served our fathers so faithfully in tilling the rocky and hard soil of the Commonwealth. I have been, for many years, a breeder of horses. There are always men with favorite mares who are willing to attempt to breed colts without much consideration of profit. I think I shall have the whole audience with me when I say that there has never been anything attempted by the farmers of the Commonwealth that has been done in such a hap-hazard way, and at so much loss, as the horse breeding of the past. It has not reflected credit upon us as husbandmen.

In raising horned stock, we are particular about breeds. We know what we want; know whether we wish to breed for milk, for beef, or for butter; we are particular about pedigree, and careful to keep races pure; the State Board of Agriculture has even forbidden the county societies to give premiums to grade bulls under any circumstances. But in the matter of horse breeding, no consideration whatever seems to enter into the mind of the farmer in regard to the family or race from which he is to breed. The result of this careless method has been, the most heterogeneous race of animals, probably, that has ever been seen among men. In the discouragement that has followed this lack of system, nearly every farmer will tell you that he can make more money in a year from any good breeding sow than he can from a mare kept for the purposes of breeding.

For the last ten years horses have been very cheap. We could buy horses from the West a good deal cheaper than we could raise them; but, as I said to the few who were here last night, there is a very rapid change coming over the horse market that is noticed by everybody who has occasion to buy. Horses for street railroad purposes have, within the last year, risen from one hundred and twenty-five or one

hundred and thirty-five dollars for the best stock, to one hundred and seventy or two hundred dollars, and buyers coming into the market during the next year for horses suitable for railroad work, or for the plough, will be compelled to pay something over two hundred dollars, and perhaps even a higher price than that. The question of breeding is, therefore, taking a new shape to the farmer. We are getting into a position where, with intelligence, we can again make the raising of horses profitable; there are those before me who can remember back to the time when there was a profitable breeding of horses in New England. We have the record of one family in the New England States that was carefully bred in the State of Vermont, that brought as much money into the State to the farmers, for a period of perhaps forty or fifty years, as any other husbandry in which they have ever been engaged, except sheep husbandry. The carrying into the State of Vermont from this very valley of the horse "Justin Morgan," that had in his veins blood potent enough to found a family (not a *race*, as has often been alleged), was of infinite value to the people of that State.

To give you an instance of the value of that stock: In 1837 there was a rebellion in Canada, and the British regiment of dragoon guards, one of the heaviest in the service, was sent over in such haste that horses were not provided for it; the men were expected to be mounted upon their arrival in Canada. The horses of Canada at that time being very inferior, agents of the regiment were sent into the State of Vermont to buy, and in a few weeks they horsed that entire regiment of dragoons with stock that the officers considered equal to the mounts of any of the crack regiments of England, whose horses were bought in the midland counties. Many of those Morgan horses were taken by the officers from Canada to England, when the regiment was ordered home, and made a creditable appearance in England, even in the hunting-field. But I may safely say that you may go over the State of Vermont, to-day, from one end to the other, and not be able to buy a respectable pair of carriage-horses. The reason is, that the people of Vermont allowed that family to die out. It was not a race; it was

nothing but an accidental family, sprung from the loins of a noble horse that had in his veins, according to my theory, which I believe has hardly been disputed in this valley, a strain of blood that very likely came from an Arabian horse that was kept at Hartford in the latter part of the last century. There was enough of some good blood in Justin Morgan to go on without being re-inforced from the outside for forty or fifty years, and make the people of the State of Vermont famous as horsemen. I stated at Springfield last winter, and I am willing to state again, that I do not believe the horses of this valley are nearly as good as they were in the boyhood of many persons here present. The last generation had great use for horses on the road. I remember when stage lines ran through this valley, from Springfield up into Canada, with horses that it would be difficult to find now, in any part of Massachusetts. All of you who are as old as I am remember it.

Now what are we going to do? We are going to raise some horses. We always do raise a few; but the question is, what shall we raise, and how shall we make this husbandry profitable, which has been so discreditable to us as breeders? The horses most in demand, and that must bear the highest price during the next decade of years, are those wanted by farmers. We need horses of more stamina, of better general quality, and of larger size than those we have had. We must have animals that are fit for the plough, the mowing-machine, the milk wagon, and quick on the road. It is poor economy to keep two kinds. We do not want a little "tucked up," lathy "trotter," such as have been bred in droves during the last twenty years, to go to town, and a slow, heavy horse at home to do a day's work.

We should combine docility of temper, steady nerve, quick action, weight and power, in one horse. We must have access to stock horses which will perpetuate their kind, and not run back into a wilderness of scrubs and produce that which will be a disappointment and expense to us every time we attempt to breed. I think we have a better way laid out for us than we have followed in the past.

For several years there has been much interest at the West in horse-breeding, because the East offers such a quick

market, and they have introduced, especially in the State of Illinois, from which they have spread all over the western part of the country, the blood of the French horse that is generally known as the Percheron. Mr. Dunham of Du Page Co., Illinois, has imported more than a thousand Percherons, and his, and other importations, have been spread all over the West. I rarely see a carload of horses come into Boston now without noticing some very marked evidences of Percheron blood. I can point them out in almost every lot I see taken through the streets. These animals are being distributed all over New England, and among them are a great many grade mares of this excellent blood. They have round barrels, good limbs, sound feet, thin heads, with small ears, not much hair in the mane and tail, fine skins, and for large horses they have quick action. This is the class of animals that should be bred upon our soil. They are just about what the Morgan horse was thirty-five or forty years ago, but about two sizes larger. You remember that the Morgan horse was well made all over, and the horse dealers nowadays will speak of him, as a sort of reminiscence, as a "Morgan chunk." They were small; there was not blood and bone enough in them. They weighed from eight hundred to nine hundred and fifty pounds; but they were capable and cheerful on the road.

You see about the hall here some of the bills that give you a knowledge of what the old Society for the Promotion of Agriculture, that for nearly a hundred years has been quietly active in the agriculture of Massachusetts, has done during the last year for the farmers in the importation of five Norman Percheron horses from France, that are placed about the State in convenient localities, to which any farmer can take a mare at a reasonable price. There is no farmer in the Commonwealth so situated that he cannot easily reach one of these horses. The horse-breeding literature of Massachusetts has, for the last twenty-five or thirty years, been managed by stallion keepers. Farmers have been induced to believe that by breeding any of their little worn-out mares, that in some cases have been half-starved in pastures in summer, and kept on meadow hay in winter, to any fashionable stallion, and paying from fifty to two hundred

dollars for service, we would get horses that would be creditable to us as breeders. The chance of doing it is as a bucket of water to the broad Atlantic. The farmers have been led to believe that by breeding their poor stock to high-priced "trotting" stallions they could produce something that, in the hands of a horse-puller, with the addition of what is called "development" and "training," toe-weights, etc., they could be sold for a high price. There is not a farmer living in Massachusetts to-day that has ever realized anything like the cost of any animal bred with that notion.

Now, the horses of the Massachusetts Society are standing in the parts of the State indicated in these bills; all in convenient parts of the State, and the fee for their service is placed at fifteen dollars. That is the old-fashioned fee, such as was charged when I was a boy, when Silas Hale of Royalston, in his white frock, used to lead out "Green Mountain Morgan" in front of the common, to the delight of the whole neighborhood. I will say, in reference to that horse, that it was one of the finest little horses that ever stood on iron. He fills my eye to this day as one of the noblest specimens of a small horse that ever was raised anywhere. I wish we had thousands of just such, only it would be better if we had them all castrated, instead of getting little colts, as he did; but he himself was a very fine horse.

QUESTION. Tell us something about the breeding of the Percherons.

The French claim that they are the oldest race in the world. As long ago as the eighth century there was an invasion of France by the Moors. It was the time of the Mohammedan conquest of a considerable part of Europe. An army of one hundred and fifty thousand or two hundred thousand men, with a great equipment of horses, passed over the Pyrenees to the centre of France, where they were met on the plains of Touraine by Charles Martel, and there their power was broken, their camps taken, and the whole of this splendid equipment was distributed over France by the conquerors. The result of that was to bring into France at that time a great number of the very best horses of Arabia, the highest type of horse, the very foun-

dation of all equine excellence, and a considerable part of this spoil of horses was awarded to the knights of a part of France then known as Perche, now not known by that name as a department. It is the southern part of Normandy, one of the two departments bordering on the Loire. That was not the end of it. The excellence of those horses was so quickly seen by the knights of France, — for a man's life then depended not more upon his arm than upon his horse, — that, in the succeeding crusades, they brought back great numbers of both stallions and mares, and the whole of France was filled with Eastern blood. That has been continued until a race has been established, a composite race, continually re-inforced either by crossing with the English thoroughbred to refine the character of the race, or else by direct importations from Syria. When I was in France, six or seven years ago, there were Arab stallions, small horses, to be sure, but brought from the very source of the blood itself into the Perche district. They were standing there for mares, and I have no doubt that subsequent re-inforcements of Eastern blood have been made. The farmers of all that district are breeders of these horses. They breed them of three sizes. They are something like Yorkshire pigs in that particular — there is the small, the intermediate, and the large. Heretofore, when we have brought a Percheron horse to New England, we have had a horse that was too large, — one of the cart-horses of France. What we want is a cross of the smaller Percheron and the animals we have in this country, and I am glad that the superior judgment of the Society for the Promotion of Agriculture has brought here some of the intermediate stock, that are about the right weight to be coupled with our ordinary mares. I regard it as a mistake to bring horses here to cross with any of our mares that are over sixteen hands high. The horses of the Society are sixteen hands high, and weigh between twelve and thirteen hundred pounds, well made all over.

The progeny of these horses are almost certain to be gray. Gray is unfashionable in this country, but I have yet to learn that a good horse was ever of a bad color. Gray is easily taken care of; it goes with a healthy, fine skin, and good hair. It is, also, in the case of these horses, an indica-

tion of the blood from which they spring; and the fact that their progeny from dark mares is so certain to follow the color of the sire is a proof of the potency of the blood; and I trust that nobody will raise an objection to these horses because they are gray. We have had enough poor horses of other colors; let us have some good gray horses, if we have to set a new fashion.

As there are but two minutes more for me to get out of this place, I leave you to work away on what I have said.

Maj. ALVORD. I want to add a few words in regard to these Percheron horses. In the first place, there is one point as to the reliance which can be placed on the horses imported as breeders. The French government, in its paternal relations to the agriculture of all France, has its breeding stations all through Normandy, where it holds for service, at reasonable rates, stud horses, exactly as the Massachusetts Society is now offering them in this State. Besides that, those stations exercise, under government authority, a supervision over all the breeding horses in France, and every whole horse, having arrived at a certain age, has to go into one of those government stations, and there pass an examination, and, unless he comes up to the standard, he is then and there castrated, and not allowed to propagate any imperfection within the limits of France, nor to be sold out of the country as a French horse. The owner of an imperfect whole horse in France is not allowed to use him as a breeder, or to sell him, but he is castrated on his hands. But with this exception, castration is seldom performed in France, because stud horses are used as much as mares for working animals, often going in the same teams. This animal, with its additional weight, keeps the quick action and other advantages of the lighter-built horse, and, despite the increased weight, you are able to keep them very easily; they are light feeders.

A year ago last August, a stallion and four mares came into my care, landed from the same boat in New York, purchased directly from their breeders in Normandy, and they have been constantly handled by me from that time to this. We purchased a horse rather larger than those obtained by the Massachusetts Society because, being near New York

City, one of the chief objects was to raise horses that should be good coach and carriage horses, to supply the demands for large horses, coupé horses, in the city of New York; hence we selected a stallion upwards of seventeen hands high. He now weighs, at four years of age, sixteen or seventeen hundred pounds. In order to make an economical team on the farm, there was purchased with him a seven-year old mare that now weighs sixteen or eighteen hundred pounds. Now that mare and stallion (she being almost seventeen hands high) make a farm team, and work together habitually just as quietly as a team of geldings, and better and more quietly than a team of mares, and she, being with foal most of the time, there are but one or two months, at the outside, in the year when there is any difficulty in working them together. I might mention three or four of the large firms in New York who are now working teams in the streets of that city composed of these animals; sometimes three mares and a stallion, sometimes three stallions and a mare, and sometimes a pair of mares and a pair of stallions, and no difficulty results. Of course they have to take the mares out at certain seasons.

Our next pair of mares were of medium size, three years old, neither having had a colt at that time, and these range from twelve hundred to thirteen hundred pounds. I never have handled a more satisfactory pair of working horses in every way. They have been used as a regular farm team for fifteen months; on the road they are as light and active as any ordinary pair of working horses. A very usual trip for us is between eight and eight and a half miles, returning with a load of about two tons, and they make that trip, going empty and returning loaded, in between three hours and a quarter and three hours and three-quarters, averaging three hours and a half. They are able to walk, with an empty wagon, very close to four and a half, perhaps five miles an hour. The only trouble about them is the danger of their being too fat for breeding. They are like an Essex pig; it is astonishing how fat they will keep without anything to eat. All through the summer seasons, with rations as low as I feel it safe, they keep altogether too fat. The ration now, during the winter, when they are on

the road five or six days of the week, is twelve pounds of oats and eight pounds of hay. That is all they get. They weigh now about thirteen hundred pounds apiece. That is not more than two-thirds — it is not much more than half — what the books will tell you ought to be fed to a horse of that weight; what the Germans put down as a proper sustaining ration for a horse of that weight.

We have one colt, a filly, dropped from the older mare this year. At four months old she weighed 375 pounds; at five months, 502 pounds; at six months, 610 pounds. There has been no time since she was four months old that you could not put a harness on her and give her a load to draw; she would draw it as steadily as her mother. Moreover, when she is a yearling she will weigh something like a thousand pounds. There is no reason why she would not now work. The older horses have not been shod. The French horses do not always have good feet. They have very broad, spreading feet. There is a greater difference in them in that respect than in any other breed. It is their weakest point generally, — the want of a good hoof to carry their extra size and weight. But from the present appearance of this filly, I am satisfied that she will work on our hard roads without shoes. It is my intention, at any rate, to see if she cannot be used right along for several years without shoeing.

The docility and intelligence of the breed are very remarkable, the handling of both mares and stallions being exceptionally satisfactory in those particulars, and the great advantage being the extra weight and size, without apparently increasing the cost of keeping, and without any loginess or slowness resulting therefrom.

The stallion, at a time when he weighed sixteen hundred pounds, has served mares weighing nine hundred pounds or less, without difficulty, and with perfect gentleness. From all the information that we can obtain, there is more to be expected from the grades than from the full-bloods. A cross of these sires upon good-sized, well-proportioned mares can hardly fail to produce horses that will be extremely useful and very salable anywhere in the Eastern States. I can hardly conceive of a greater public benefaction than the

importation of these five Percheron stallions, and placing them on service here at a merely nominal cost. I do not know anything about what the Massachusetts Society have obtained, but I will venture to say that those five horses, if they are what they call "approved" by the French government (as they must be, for they must have the French seal of approval before they can be exported), they must have cost, landed in the State of Massachusetts, not less than ten thousand dollars, even if they came in duty free; I do not know how that was. So that with the risk attending it, a service-fee of fifteen dollars to insure a foal, is certainly next to nothing; and I especially wished to state this experience in handling some of this same family of horses for a year as a matter of encouragement, so that those who have mares and breed at all, could feel assured that, if they bred them to these horses, they would be fully satisfied.

QUESTION. I understood you to say that there was no danger in harnessing these colts at four months old, and puttingthem at work when a year old. Was I correct?

Maj. ALVORD. It is quite customary to find them in full working order, at home, at two years old. I say that this colt, from present appearances, will be fit and ready in every particular for light work, and probably just as well off for it, at one year old as if it were postponed to a later period.

QUESTION. Would Maj. Alvord recommend the breeding of these horses from the fact, as he says, that they can be put at work at a year old? Is that one of the reasons why they should be used?

Maj. ALVORD. No, sir. But if this filly weighs a thousand pounds, as I believe she will, from present appearances, next May, when a year old, I shall not hesitate to work her. I do not believe it will hurt her any more than it hurts a Jersey heifer to breed her when she is two years old. I do not see any reason for not doing it. As two-year-olds, they are pretty well matured, although our three-year-olds have not bred; have been growing on our hands. By the way, I will say in regard to this big mare that we have, weighing eighteen hundred pounds, that we use a three-horse horse-power to run a threshing-machine where three common horses are used, and that mare's regular work

during the winter has been on this threshing-machine working alone.

Question. Will you please tell how that colt is fed?

Maj. Alvord. We did not wean it early, and it got nothing but mother's milk until it was three months old. It is now eating oats and hay; it has had a little bran mixed with the hay, but chiefly oats and hay.

Question. What is the color of the stallion you imported?

Maj. Alvord. Gray. All five of our animals are gray, and the filly is gray. I saw in New York, two hundred and sixty-two stallions that Mr. Dunham imported at one time, and I should say that one-third of them were other colors than gray. There were some jet black, others white, not gray, and he had quite a number of bays. Those are the only colors I have ever seen among Normandy horses. They must be kept distinct from the Clyde horses, — Scotch, not French, — which are being more bred in the Eastern States than the Normans, and which are heavier about the limbs, which have much more hair about the feet and legs, and are slower, heavier horses every way. Among the Clydes you will find different colors, — chestnuts, sorrels and roans; but I have seen in the Normandy horses nothing but black, bay and gray, coming down to white.

Mr. Shepard. I understood Mr. Russell to say that the gray color was traceable to the Arabian, and that we cannot afford to dispense with that color for fear of losing the strong blood of the Arabian.

Maj. Alvord. Certainly four-fifths of all the horses that come over from France are gray. I wish to say that the mares foal very easily indeed. The mare that had this colt was worked full-work up to within a month of the day she had a colt, and half-worked, although the weather was pretty hot in May, up to within a few days of her time, and was worked again in the course of a couple of weeks after she foaled.

These horses are all admirably well-proportioned, and there are small and large sizes. The extra large horses, that the French are ready to sell, that you can buy cheapest in France, are those which have generally gone into the West.

Mr. Dunham told me that he could buy those large horses cheaper, and sell them for higher prices in the West than any other horses, but they were the kind he would not have on his farm for his own use. He recommended a medium size, and it was with a good deal of satisfaction that I heard the statement here as to the size of these stallions, and found that the Massachusetts Society for the Promotion of Agriculture, which generally knows what it is about, had brought over the right kind.

QUESTION. Will you tell us the quantity of hay and grain fed to the colt?

Maj. ALVORD. I do not think that colt has ever been fed all the oats it could eat. It is the only horse that I have under my care that I allow to have all the hay it will eat. The colt is fed now about three quarts of oats a day, just about what the full-grown horses get. It began by eating oats out of its mother's box. It has a little bran occasionally, for a change—perhaps a pound of bran substituted for a pound of oats; never half bran. It is occasionally given a root. It came almost black, and is now shedding its hair, and is going to be a medium gray.

Mr. SHEPARD. I think the audience might be misled by the remark of Maj. Alvord in regard to working the colt. I understand him to mean barely using the colt what he would naturally exercise, and no more. I know, from my own experience, that when you begin to use a colt he goes very nicely, and you take too big a load. That is the trouble with colts.

Now we are speaking about colts, perhaps I can give a little information in regard to the first using of colts. I have never known a colt harnessed for the first time that did not go off well. The next time he may not go a step. If you force him with the whip he falls and breaks a shaft. I have studied to know why he had changed his disposition, and I think I have found out why it is, in many cases. If you had gone out and used an axe until your hand blistered, when you took hold of the axe the next day you would know what the trouble was. This colt has blistered his shoulder, and when you undertake to force him to go up to the collar, he refuses. If you will examine that shoulder, you will see

what the trouble is, and not attribute it to the disposition of the colt. I don't believe there ever was a bad-tempered colt, and I have had a great many. The fault is in the man. Our balky horses are made by the drivers. A horse can learn almost anything that man can learn in language.

The discussion here ended, and the convention adjourned, *sine die.*

ANNUAL REPORT OF THE COMMISSIONERS ON CONTAGIOUS DISEASES AMONG CATTLE.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

The Commissioners on Contagious Diseases among Cattle, in submitting their annual report, are happy in being able to convey the information that the past year has been one of almost unparalleled prosperity to every department of our neat-stock interest. As in former years, the municipal officers of many towns and cities have notified our board of supposed contagious disease within their jurisdiction; but an examination proved in all cases that such was not the fact, and that the diseases, though in some places causing considerable individual loss, were ordinary sporadic complaints, the causes of which were purely local, and with no contagious or even epidemic character. The known fact that contagious pleuro-pneumonia exists in several States of the Union, between which and ourselves there is more or less exchange of cattle, and that our railroad connections are such that Spanish fever may be brought here by any stock-train from the cattle-ranges of Texas, causes a constant apprehension among the owners of neat-stock, especially when their animals are of great value. Therefore, when any distemper afflicts their herds with some symptoms similar to those of the diseases named, alarm takes the place of apprehension, which calls for the services of the Commission, and which it is very difficult to allay. Though for the last three or four years these fears have been groundless, yet the fact remains, that we are in constant danger, and shall continue so, until by the action of the national or state government, or of both combined, the former of these diseases is eradi-

cated from our territory. Our citizens have enormous pecuniary interests in the cattle-ranges of the Western plains, the stock of which can be preserved from this disease only by untiring vigilance. The losses by it in Australia have amounted to more than a hundred million of dollars; but this loss is small compared with what must ensue if it should make its appearance among the countless cattle of the far West. We cannot refrain from calling the attention of the legislature to these facts, and intimating that our interests call for some action to awaken the general government to the adoption of a comprehensive plan to ensure the public safety.

The efforts of the Commissioners during the last three years, and the modification of the laws relating thereto, appear to have produced the desired results of diminishing the disease called glanders, and the cost of controlling it. During the year 1881, we were called by municipal officers to take charge of fifty-seven cases, in forty of which the animals were condemned, and ordered to be killed. The present year we have been called to twelve cases, and have caused seven animals to be killed; in addition to which three have been killed by the selectmen of different towns without the interference of the Commissioners. The legislature of 1882 appropriated two thousand dollars for the purposes of the Commission that year. Of this sum there has been expended in bills paid or now outstanding six hundred sixteen dollars and fifty cents ($616.50), leaving an unexpended balance of thirteen hundred eighty-three dollars and fifty cents ($1,383.50). If by the provisions of law this balance now reverts to the general treasury, it will be necessary that another appropriation be made, and as a measure of safety against emergencies which are liable to occur, it should not be less than that of 1882, though it is hoped there would be no occasion for its expenditure.

LEVI STOCKBRIDGE,
E. F. THAYER,
H. A. JORDAN,

Commissioners on Contagious Diseases among Cattle.

ANNUAL MEETING OF THE BOARD.

The Board met at the office of the Secretary, in Boston, on Tuesday, February 6, 1883, at twelve o'clock, His Excellency Governor BUTLER in the chair.

Present: Messrs. Anderson, Bird, Buell, Damon, Farnsworth, Fay, Grinnell, Goodrich, Haskell, Herrick, Hill, Hadwen, Hersey, Jewett, Lane, Lynde, Mayhew, Moore, Noble, Round, Slade, Sessions, Taft, Varnum, Ware, Waterman, Wheeler and Wilder.

The minutes of the last meeting were read and accepted.

Voted, To adopt the order of business of the last annual meeting.

Voted, To meet each day of the session at 9.30 o'clock, A. M. and to adjourn for one hour, from one to two o'clock, P. M.

Voted, To appoint a committee of three to examine and report on the credentials of newly-elected members: Messrs. Grinnell, Taft and Wheeler.

Reports of delegates to the annual fairs being in order,—Mr. Mayhew reported on the Middlesex North, Mr. Round reported on the Middlesex South, Mr. Anderson reported on the Worcester West.

These reports were laid on the table.

His Excellency the Governor asked that the Board would give Mr. Chamberlain of Cambridge an opportunity to be heard on cranberry culture.

Mr. Moore was appointed to confer with Mr. Chamberlain and to arrange a convenient time for his appearance.

Adjourned for one hour.

Met at two o'clock, P. M., Mr. Grinnell in the chair.

Mr. Moore reported that he had arranged with Mr. Chamberlain to appear before the Board at two o'clock, P. M., Thursday.

The report was accepted, limiting Mr. Chamberlain's time to fifteen minutes.

Mr. JOSEPH STORY FAY read his essay on "The Value of a Protective Tariff to the Farmer," which was laid on the table.

THE VALUE OF A PROTECTIVE TARIFF TO THE FARMER.

Gentlemen of the State Board of Agriculture of Massachusetts :

As delegate from the Barnstable Agricultural Society I thank you for the honor you have done me in appointing me to address you on the value of a protective tariff to the farmer. I approach the subject with some diffidence as to my own power of treating the subject to the best advantage, but with not the least doubt as to the soundness of the negative position I shall take, and I ask your indulgent attention. I do not propose to detain you with an elaborate essay. I shall only submit to you a few facts and considerations that the busiest may have time to think about, and those the least familiar with the subject can understand. We know that all articles raised by the farmer, or coming from the soil, have a ready sale for *cash*, and that the producer can at once realize the results of his labor. There are manifold uncertainties in his business, but after all the vicissitudes, beyond those of any other worker in any branch of business in these United States, such as the changes of weather, wet or dry, cold or hot, wind or storm, and worm or blight, the tiller of the soil knows that what he secures will bring him its value in money. His profits, however, even in the best of seasons, and with the largest of crops, are not so great, that it is not desirable that what he receives may avail him to the utmost. The effect of taxation upon him, therefore, is important: first, as it may affect the cost of what he has raised ; and, second in making the proceeds go as far as possible in supplying his wants or in adding to his small savings and capital. As things are at present, the fact is, that though he sells for *cash*, he has to rebate to *somebody*, at least thirty, if not forty or fifty per cent. of what he receives. I will now proceed to give you a few

figures from a pamphlet issued by the national bureau of statistics. From this it appears, that the value of imports of foreign goods last year, at their cost abroad, amounted to 716,000,000 dollars, of which the value of 211,000,000 was of free goods; such as tea, coffee, hides, chemicals, etc., leaving a value of 505,000,000 on which duties were paid to the amount of 216,000,000 dollars, an average of 42⅔ per cent. Think of adding this amount to the foreign cost, besides freight and other charges!

The exports of merchandise during this period were valued at 733,000,000 dollars, of which the value of 552,000,000 were the products of agriculture, or seventy-five per cent. of the whole.

Of the whole amount of exports, only a little over one-eighth, or 103,000,000 worth were manufactures, or less than two per cent. of the total manufacturing product of the country for 1880. And to make up this sum, manufactures of wood (meaning lumber) to the value of 19,000,000, of tobacco, spirits, spirits of turpentine, sugar and molasses, and many such articles have to be included. Now if the duties on the total 716,000,000 of imports, free and dutiable, are 216,-000,000, or an average of thirty per cent. on all, dutiable or free, does not the country have to pay those 216,000,000 into the public treasury, in addition to the 733,000,000 value of merchandise sent away to buy them, and does not this vast sum come out of the pockets of the consumers, by the increased price of everything they have to buy? And does not the chief burden fall upon agriculture, the most important interest of the nation, and upon agriculturists, who are the largest class, whose products and labor have furnished the bulk of those exports?

In the old days of nullification, when there was much strife and much intelligent discussion upon the effect of foreign imposts, when laid for protection, Mr. McDuffie of South Carolina maintained the theory, the duties at that time being on the average forty per cent. upon goods imported from England, that if he sent 100 bales of cotton there to be sold, ordering the returns in goods, when they arrived, he had to give the United States government 40 bales more to pay the duty on the clothing, hats, shoes and blankets in

which he had ordered the proceeds of the 100 bales to be invested, thus making the 100 bales worth of goods cost him 140 bales of cotton. And this was no fallacy. It was true then, and it is true to-day. If I send 100 barrels of cranberries from my Cape Cod place, or you 100 barrels of apples from your inland farm to England, and bring back dutiable goods in exchange, we must have the proceeds of 43 barrels more in our pockets to pay the government for the duties on the goods. Even if we ordered the amount in trees, or plants, or seeds of any kind, paying a duty of twenty per cent., it would be 20 barrels on a hundred, and does this protect us? The total amount of value of seeds imported last year was $1,465,170.18, paying duties $281,038.84. There is not only no protection to us in this, but actually a barrier in the way of introducing improved seeds and plants into the country, only to increase the surplus in the public treasury at our expense, to be squandered at Washington. If it be said that you and I will bring home gold for our apples or cranberries, we cannot buy at home what we need without its cost being increased by the duties the importer has to pay on it, be it silk or merino dresses for our wives and daughters, coats and hats for ourselves, or steel ploughs or trace and log chains for our farms. You cannot escape the *fact* that you buy a great deal less for your money at home than abroad, and while the price of what you raise and sell is fixed by what it is worth in the foreign market, the price of all you want to buy here of foreign make, is fixed *here*, and the cost is increased by the duty, averaging nearly forty-three per cent. That a tax increases the price of goods is illustrated by the fact that common whiskey, worth 25 cents a gallon, is increased by the duty of 90 cents to the market value of $1.15, and the same is the effect on the price of tobacco. This increase of price by the tax, which is here clear and palpable, will apply, though less apparently, to all the articles imported from abroad, be they sugar (three cents a pound), or salt, clothing, hats or blankets, iron or steel, or manufactures thereof. There is no doubt that the prices of the same class of goods made at home are enhanced in equal ratio to the foreign goods which compete with them. If any man tells you that our protected manufacturer makes

goods cheaper than they are made abroad, ask him then, why he does not sell them at a price at which they can be shipped to South America, India or China, to compete with those same foreign goods sent to those markets from England, Germany and France? Why must our exports be mainly agricultural, if our manufacturers can afford goods cheaper than the foreigner? In addition to the 216,000,000 of dollars duties collected on foreign imports, there are 155,000,000 of internal revenue taxes collected, of which whiskey and tobacco, the products of agriculture, pay a large part. Of course these are luxuries, and we are not obliged to use them, but it makes in all a total burden of 366,000,000 dollars to fall upon *somebody*, and it cannot be a good thing. The principle is wrong to gather up this vast sum, to distribute it again, who knows where? It may be said that, if these 350 to 400,000,000 dollars a year (the latter is Mr. Folger's estimate for the current year) are gathered in taxes, the amount is all spent at home, and that the country is not the poorer for it.

Suppose this is admitted, does it not make considerable odds to whom the money goes, for it does not get back to those who contribute it? It goes from your pockets, first, to a standing army of tax gatherers, and what is left, to those whose coffers are already full. Do you know a farmer who has become a millionaire by farming? You may count them by dozens among those whose occupations and business are protected, but not among the farmers! The president of the Singer Sewing Machine Company lately died, leaving a dozen or more millions of dollars made from a business eminently protected, and from machines mainly distributed and sold among the working-people of this country. From the increased cost by duties on steel, and other causes involved in protection, these machines are too dear for profitable export; but how is this met? These capitalists build an immense factory in Glasgow, where, untrammelled by tariff, and by using foreign labor, they can supply machines to foreign work-people at one-half or two-thirds of the cost of the protected machines which you *have* to buy. But for the duty, you could import a Singer, or other sewing machine, at two-thirds of the price exacted from you here, or less.

As the thing stands now, with all the large sewing-machine factories in the country, making millions of machines yearly, you furnished for export in 1881, a greater value of fresh and dried apples than was the amount of value of those machines sent abroad in that year. The same facts apply to watches, an article of so large demand and use, and in the manufacture of which the Americans claim the pre-eminence. It is fifty years since the duties on imports were laid in a way to foster and protect "our infant manufactures." To-day the duties are heavier, when we boast of American skill and the perfection of American machinery, than they were at the start, and now when its products amount to $5,369,579,-191 per annum.

Twenty-two years ago, a sweeping tariff and an excise law were enacted as a war measure to sustain the credit of the country, and to meet the expenses of the contest for the Union, taxing almost everything to the utmost, and thus neutralizing, in many cases, the effect of the very protection desired, but putting an immense burden upon all. With all its crudities and inconsistencies and faults that tariff has never been materially changed. Indeed, some classes of manufacturers are clamoring for an increase, while some have actually obtained it, that these "infant" productions may make more millionaires. As for example: the only manufacturer of large plate glass such as we see in shop windows, demands a protection of one hundred and twenty-one per cent., and he lives in Indiana, beyond the Alleghany Mountains. This duty prohibits those who use it from getting supplies from abroad, where it is much cheaper. You were willing to sustain the burden of war, in whatever shape it came, but does not the peace of seventeen years' standing call for a relaxation, when at the present rates of revenue, there will be no public debt in twenty years, and nothing on which to base the security of the national banking system, by which you have a sound paper currency? What country has a better credit than ours, and can it be made better by unreasonable and grinding taxation, enriching the few at the expense of the many?

See, too, the temptations, with the overflowing treasury, to corrupt schemes, useless expenditures and extravagant

constructions, if not to fraud and stealing! And what protection does the farmer get? You and I know very well that so long as we raise more than can be consumed at home, and have to seek a foreign market for our surplus, no farm productions can be imported to compete with us; hence, even with the low rates of duty on cereals and the like (not over twenty per cent.), none can ever come in, except from an entire failure of crops with us, and a famine were threatened. And if foreign markets must be had to take our hundreds of millions worth of produce, and if we must take such prices as they can afford to give us, ought we not to have the privilege of buying, with the proceeds of what we ship, the cheap goods which they have to sell, rather than be forced by almost, or quite, prohibitory duties, to buy of our protected manufacturers at nearly double prices? If we could take more of their goods in return, and get them home, with a moderate revenue duty, would not foreign nations be able to buy more largely of us, and at better prices? Would they not be better customers to us if we did not exclude their products, and if they could sell us more, not having to pay us in hard cash for what they are *obliged* to take from us? In 1881, they had to pay us in gold a balance of ninety-one millions of dollars, seriously disturbing the finances of Europe.

And now, to make some specific points upon protection, let us look at the article of salt, on which a duty of about eight cents a bushel, or forty-six per cent. is levied, and for what? To protect those who own the salt-wells of Western New York, Michigan, and Virginia. Do you ever buy their salt? No! You must use the foreign article, because the Western is too dear, and must pay also heavy transportation charges. Theirs is a monopoly, and they combine to produce as much, and only as much, as they can sell at protected prices, and should they have a surplus, send it to Canada and take what they can get for it, rather than make a concession to us, or to those who, at the West, are obliged to have it for packing purposes. It is the principle on which the Dutch used to act in burning the surplus nutmegs to keep up prices. There are other things worked in the same way, and notably among them are the copper products of Lake Superior. The

mining companies sell all the copper they can at about eighteen cents a pound to the consumers in the country, and the surplus that cannot be used here is sold to go abroad, or sent there to a market where it is worth, at the outside, $15\frac{1}{2}$ cents for the best. Last year the exports of copper, out of a product of 27,275 tons, or fifty-four and one-half millions of pounds, worth nearly ten millions of dollars, were 3,340,531 pounds, at a home value of $17\frac{1}{4}$ cents a pound, amounting to $565.295; and the imports were 744,566 pounds, costing abroad $12\frac{4}{5}$ cents a pound, and amounting in value to $90,945, which paid a duty of five cents a pound. This is about the loss that the copper miner makes on his *surplus* after selling you all he can at 18 cents a pound, and it shows plainly that a protective tariff gives him a monopoly and forces the people of this country to pay several cents a pound more for all the copper they use than any other people in the world.

Where is the sense of it, except to fill the pockets of a few owners of copper mines? These do not need it as protection, for they can produce it as cheaply as it can be produced anywhere else. One mine alone (the Calumet and Hecla) has paid to its owners, in about twenty years, dividends to the amount of over twenty-one and one-half millions dollars, with several millions surplus on hand, on an original investment of $200,000. Can any such profits as this be shown in agriculture? Suppose, for a moment, that one of our neighbors should discover the most valuable copper mine in the world on his farm, should we not think it hard, if, in addition, Congress should pass a law making the rest of us (who get no bounty for raising corn or pork) pay him a bonus of five cents a pound on his product? And yet, this is practically done for the copper miners. The price of five cents a pound is added to the fifty millions of pounds mined and used in this country, and we farmers pay our full share of it. And as though this were not enough, that they should have a *full* monopoly, an almost prohibitory duty was laid upon copper ore, and the business of smelting it not only was actually destroyed, but also the foreign commerce based upon it. Formerly ships loaded with American goods sailed from Boston to Chili, and in return brought back copper ore, which was smelted at Point Shirley, East Boston,

with American coal and by American labor. Now, the whole is a thing of the past, — taxed out of existence. The decay of American shipping is not a matter of wonder when such one-sided legislation can prevail and pass without protest or complaint.

But to recur to the salt tax. When it was first imposed it was partly with a view to revenue, as salt, a necessity of life, has always been a favorite subject for monopoly and impost, and partly to protect the salt-makers on our coast. These, before the Western salt springs were worked, covered our sea-shores with thousands of acres of salt pans, making salt by solar evaporation. Now there is not an acre of them, and what good to us, or to anybody, is a protective tax on salt?

We will now look at wool as a protected article, as that is one of our farm products. Did you ever hear of a pound of wool raised in the United States, east of the Rocky Mountains, that was sold at twelve cents a pound or under, or even at sixteen cents or less? Yet wool of this character, long and coarse, coming from Asia, Africa, South America and Mexico, at a cost of twelve cents or less a pound, pays a duty of three cents a pound, and if only one mill over that, up to twenty cents, a duty of six cents a pound. Now the American wool-grower needs no protection from such wool as this! Yet this class pays sometimes, 7,500,000 dollars a year, into our over-flowing public treasury. It is used for carpets, blankets, flannels and other coarse goods, that our laboring classes need to use, and enhances to that extent the cost of them. And then what is the result to our "infant manufactures?" They must be protected against the foreign goods made in England and Germany, out of this same coarse wool, rendered more costly to our own manufacturers by the duty I have named, and so the cheap carpets, blankets and clothing which come from abroad, must pay a still heavier proportionate duty. The impost on low-priced blankets is eighty-five per cent. (almost or quite prohibitory), and the American working-man must pay one dollar and eighty-five cents for what the English laborer pays but a dollar. The duties on the finer qualities of wool are much higher, and in spite of them, large quantities are

imported, because we do not raise enough to supply the demand for our woollen mills which are heavily protected on the goods they make. You can buy nothing made of wool for your personal or domestic use, that does not pay a duty of at least fifty per cent.

How can we make money and become millionaires, or how can our farm hands afford to work for the wages we can afford to pay, when the cost of everything is enhanced by needless and cumulative taxation? Take the fine wool that is raised in New England, if it has ever been increased in price by the duty of ten and twelve cents a pound imposed upon foreign wool of the same class, adding that much to the cost of the domestic manufactured goods, it is but a drop in the bucket, compared to the amount of tax you have to pay, directly or indirectly, on all that you wear or use, except tea and coffee, and some few other articles, and among them eggs and feathers, which are duty free.

Raw hides come in duty free to the amount of 27,500,000 dollars; the cattle growers and slaughterers do not ask protection; the leather trade flourishes, and we get our shoes, harnesses and the like, by so much the cheaper. This rule or policy could be extended much to our advantage. Then look at steel. A duty of three cents a pound is levied on the greater part of the large quantity imported. Some classes pay more, but none less than two and a quarter cents a pound. You well know how much this article enters into the cost of your implements, and of the machinery which makes so many of the articles necessary to you.

Again, let me ask, how then has protection helped the farmer? In answering this question, let me call your attention to a point worthy of note and of thought, made by Mr. Carlisle of Kentucky, in a speech in Congress last year. The protection of the tariff is given under the specious and attractive cry of protecting American labor against the pauper labor of Europe, but where does this come in? I cannot see, when we are forced to send, as has been done for two years past, an average of 650,000,000 dollars' worth of produce a year across the ocean, to be sold in competition with the poorest and meanest paid labor in the world, that of Russian peasants, and of the half-starved and half-

naked Hindoos! While the manufacturers, furnace men, iron and machine makers and miners are protected against the well-paid artisans and skilled laborers of England, France and Germany, whose wages have been shown to be as high as those in this country, the *agriculturist* has to compete with the lowest grade of labor on earth, and without the privilege of reciprocity. If it be said that you have a better home market for what you raise; on the other hand it must be admitted, that a very large amount of your surplus productions, amounting to 552,000,000 dollars last year, and in 1881 to 730,000,000, would have been lost entirely but for the foreign market.

You do not dispose of all you can at high prices, as do the salt-makers and copper-miners, and sell the surplus *only* at a sacrifice. It is one price for all. Is it not due, then, to this *immense* interest that some attention should be given to build up and improve this foreign market, rather than to spend all legislative effort in raising higher barriers to keep our produce at home?

The protective system has not worked so well that you find a home market for all that is raised, and the market you have to seek abroad is not replaced or made needless by the one it is attempted to build up at home. The last census shows that there were employed in the manufacturing establishments of the United States 2,738,895 men, women and children, or a little over five per cent. of the whole population, and the profits earned upon the products of their labor by the manufacturers, in the year 1880, were $1,024,801,847, or over one thousand millions of dollars. If these are "infant manufactures," the profits are surely not infantile.

It is well, then, to look at these things squarely and fairly, and ask how much good does the *farmer* derive from the tremendous import tax of 216,000,000 dollars paid last year? For it must be borne in mind, that if by this tax the price of foreign goods imported is raised from thirty to fifty per cent., the domestic article is not sold any cheaper for the same quality. As a rule the selling price of home manufactures is fixed at little, if any, below that at which the importer offers to sell you his duty-paid goods. I could go

on almost endlessly to illustrate the hardships of a system that, in many cases, is like the tax on mortgages, a double exaction, but this is not the time nor the place to exhaust the subject.

What I have said may open a fresh line of thought to you, and raise many important questions in your minds. Perhaps none will be more pertinent than to ask, such being the state of things, what have our senators and representatives in Congress been about, that these abuses have now gone on these many years, without protest or remonstrance on their part, nay, even with apologies and defence? They may think only of the wealthy iron companies, the machine makers, the cotton and woollen manufacturers, of those who have their capital in mines, in banks, and in land-grant railroads, but not of *you*. Perhaps they do not know enough; perhaps they owe their election to the men who rally their work-people to the polls on the cry that the protection to their business is in danger, and that the wages of their operatives are threatened, and that the mills must close. They say nothing about the fear for their own large dividends and immense profits, but strive to leave all the burdens upon the shoulders of the agriculturist.

Much, very much more, could be said; much about the dwarfing of our commerce and the decline of shipping; for none can say, when eighty-four and a half per cent. or nearly seventeen-twentieths of our foreign commerce is done under foreign flags, and when the stars and stripes have almost disappeared from the ocean, that protection and navigation laws have promoted our growth and prosperity in this direction. It is, however, enough in itself to awaken our serious reflection to repeat, that the exports of agricultural products from the United States were last year 552,000,000 dollars, forming seventy-five per cent. of the whole; that the returns of these exports in foreign goods paid a tax of 216,000,000 dollars, and that the surplus revenue from all sources, applied to the premature payment of the public debt, over and above all the extravagance of expenditure at Washington, was 145,000,000 dollars.

Why should this tremendous sum be exacted annually from the hard-working people of this country? Who grow rich by it? Look around you and you will see that it is not

the *farmer*. You may not feel any particular pinch, it operates so insidiously, this indirect mode of taxation, but *do you grow rich?* Do you even make a good living out of it? Those who gather the spoils will appear if you look at the large dividends of the various classes of manufacturers and machinists, and implement makers, and miners, and while only $5\frac{1}{2}$ per cent of our population is engaged in these pursuits, look at their profits, look at their accumulations in the way of "plant" or investment, constantly adding mill to mill, shop to shop, furnace to furnace, rolling-mill to rolling-mill, out of their profits, besides the regular dividends. Look at the large establishments built in this State by the accumulations acquired by protection, which gives to certain classes a practical monopoly and large assured profits. Look at the large mills and factories all over this great Commonwealth, see how they grow — while farms dwindle and diminish in value. In a late debate in the United States Senate, a statement was read from the "Hartford Courant," of the dividends and the prices of the stock of some of the manufacturing companies in Connecticut, and among them, the Southington Cutlery Company, whose cash dividends, the last year, were twenty and a half per cent. Mr. Platt explained that these dividends were declared on their nominal capital, but their real capital was, in many instances, several times as much. An unfortunate explanation or admission, for whence came this "real capital," but from accumulated profits put into the business (and into increased buildings and machinery piled up), in addition to large semi-annual dividends? And so it is in old Massachusetts! No wonder that our young people leave the farm for the lighter work and greater emoluments of protected industry! After all I have stated, I would not be understood as advising, even if the people were agreed upon it, any *sudden*, radical change. It should be gradual, but it should be *begun*. I would not hastily impinge upon what may almost be considered vested rights. However good the *principle* of free trade may be, "buying where we can buy cheapest, and selling where we can sell dearest," we have been so long building up another system, that to stop it suddenly would be ruinous to all; but now we are so large and independent a nation, ought we not to rise above

a one-sided system, and gradually, at least, amend it? Ought we not to ask that some of the hardships and inequalities and much double taxing, the protection so called which does not protect, should be looked into and dealt with wisely and in a statesmanlike manner and corrected?

Is not the present tariff too much adapted to hold up (not to *build* up, for they are already built) certain classes at the expense of the farmer? Must there not be something wrong when everybody else gets rich, while this, numerically the largest class, grows poorer? Why must a revenue of four hundred millions of dollars be collected, when only eighty, or at most one hundred millions, are required to maintain our national credit, pay our interest, and extinguish gradually the public debt, and as much more for the economical administration of the government? Why should not the farmers demand, and the demand be yielded to, that economy and simplicity shall be the rule of the government, as it is in their own households, and a lighter weight of duties and taxes be imposed upon them?

Suppose our iron and machine makers, miners, manufacturers and railroad men should grow rich less rapidly than for the last twenty years, would it be any *evil?* Would not a return to simple, republican, purer and calmer ways, with less feverish excitement, less of luxury and show, be a public and national advantage?

I may be told that Congress is now at work in this direction. I hope it may be so, but there are those who know better than I, who say it is a sham and a delusion; that they are not honest and sincere, or in earnest; that they are only doing as those "that keep the word of promise to our ear, and break it to our hope." If so, they are playing a very dangerous game.

It is commonly said, and with much truth, that we inherit our opinions on religion, politics and finance. I confess that I inherited, or imbibed early, a conviction that protection was needful to our progress and prosperity as a nation. Experience and observation have satisfied me that it was a mistake, or if it was correct, that we have got beyond the period when it was needed. With our vast heritage of free lands and a virgin soil, I feel that it had been better for us

to have trusted to our own unaided efforts and our natural progress, rather than to have fostered special industries, and to have built up privileged classes, an aristocracy of wealth, as objectionable as an aristocracy of land.

The facts satisfy me that I was mistaken, and that the freest commerce possible with the nations of the world, would have given us, in the long run, the largest benefits as a people. We do not ask for a tariff or Chinese wall of prohibition between the other thirty-seven States of the Union and ourselves, and the principle of free commercial intercourse which we have with them would have applied equally, and would have worked as well with foreign countries. We should be *laughed* at if we were to ask Congress to protect us against Western grain, pork, butter, apples, and the like, but we know well that they are brought to the doors of our manufacturing neighbors, and that they will pay no more for our products than for them. We even know that Western produce goes to depress the value of what we raise.

In spite of this, however, let our aim be to extend our markets, while we lighten the burdens of taxation, and thus cheapen the cost of our living, and of production. Let us approach the subject, not in the spirit of partisanship or sectionalism, but as patriots, and intelligent, thinking men.

Let us try to cast aside prejudice and inherited notions and look at the things around us by the light of facts, and broaden our views, and endeavor to bring it about that there shall be no favored classes, but that we shall all stand on the broad platform of equal rights, equal burdens, equal privileges.

Dr. Jewett reported on the Worcester Society, Mr. Herrick reported on the Worcester North-west, Mr. Sessions reported on the Hampshire, Franklin and Hampden, Mr. Ware reported on the Hampshire, Mr. Buell reported on the Highland, Mr. Goodrich reported on the Hampden, Mr. Farnsworth reported on the Hampden East, Mr. Taft reported on the Union, Mr. Damon reported on the Franklin, Mr. Slade

reported on the Deerfield Valley, Mr. Moore reported on the Berkshire, Mr. Noble reported on the Hoosac Valley, Mr. Lynde reported on the Bristol, Mr. Wheeler reported on the Plymouth, and Mr. Noble reported on the Hingham.

Adjourned to nine and a half o'clock on Wednesday.

SECOND DAY.

The Board met at nine and a half o'clock A. M., Mr. GRINNELL in the chair.

Present: Messrs. Buell, Bird, Bowditch, Damon, Davis, Edson, Farnsworth, Fay, Grinnell, Gaylord, Gleason, Goodrich, Goessmann, Haskell, Hadwen, Herrick, Hill, Hersey, Jewett, Lane, Lynde, McKinstry, Moore, Nye, Noble, Round, Slade, Smith, Sessions, Taft, Waterman, Ware, Warner, Wheeler, and Wilder.

The Committee on Credentials, to which was referred the credentials of newly elected members, respectfully report that they have attended to that duty and find the following duly elected:—

Marshall P. Wilder appointed by the Executive.
Nathan Edson of Barnstable, by the Barnstable Society.
Jonathan Buddington of Leyden, by the Franklin Society.
W. L. Warner of Sunderland, by the Hampshire Society.
Everett A. Davis of Tisbury, by the Martha's Vineyard Society.
A. C. Varnum of Lowell, by the Middlesex North Society.
Lewis C. Nye of Blandford, by the Union Society.
J. P. Lynde of Athol, by the Worcester North-west Society.
J. O. McKinstry of Southbridge, by the Worcester South-east Society.

The report was accepted.

Messrs. Ware, Smith and Slade were appointed a committee upon changes of time for holding fairs.

Messrs. Slade, Varnum and Lane were appointed a committee upon the assignment of delegates to the fairs.

Messrs. Hadwen, Moore, Wheeler, Davis and Haskell were appointed a committee upon the country meeting.

Mr. Sessions reported on the Barnstable Society, Mr. Smith reported on the Dukes County Society, Mr. Hersey reported on the Amesbury and Salisbury Society, Mr. Gleason reported on the Essex Society, Mr. Bird reported on the Worcester North Society, Mr. Gaylord reported on the Worcester South Society, Mr. Varnum reported on the Marshfield Society, Mr. Grinnell reported on the Nantucket Society, Mr. Haskell reported on the Worcester South-east Society, Mr. Bowditch reported on the Housatonic Society.

These reports were laid on the table.

The report of the Committee on the Agricultural College was submitted, Mr. Damon making that portion relating to the college instruction, and Mr. Slade that upon the farm. Both reports were accepted.

Mr. Hersey presented a petition from Mr. Blackwell, asking a hearing upon the question of Sorghum Culture.

Voted, To hear Mr. Blackwell on Thursday, after the hearing that had been appointed for Mr. Chamberlain.

Adjourned for one hour.

The Board was called to order at two o'clock by the Chairman.

Voted, That the time of an election of a member of the Board of Control of the Experiment Station should be at eleven o'clock A.M., on Thursday.

The Committee on Time for Holding Fairs reported that the following changes were asked: Hingham, from September 12th and 13th to 25th and 26th; Amesbury, from September 21st and 22d to October 2d and 3d; Worcester, for the 20th and 21st. These changes were voted.

Voted, That the Secretary be instructed to procure a suitable place for the next annual meeting.

Messrs. Lynde, Hersey, Buddington, Damon and Sessions were appointed a committee to prepare suitable subjects for essays to be read at the next annual meeting, and to appoint committees upon them.

The Committee on the Country Meeting reported that invitations had been received from Worcester, Lowell, Palmer and Lancaster. It was voted to hold the meeting at Lowell, the first Tuesday, Wednesday and Thursday of December next, and Messrs. Varnum, Moore, Ware, Bird, and the Secretary were appointed a committee of arrangements.

Voted, That but one member of the Committee of the Agricultural College be allowed to resign, and that two members be elected, making the committee consist of six instead of five, as heretofore. Messrs. Varnum and Buddington were elected.

Messrs. Noble, Lane and Goodrich were appointed a committee to appear before the Committee on Agriculture of the legislature, and oppose the granting of the petition for the incorporation of the Hillside Agricultural Society.

The Board then proceeded to elect a Secretary for one year, by ballot. John E. Russell was chosen.

Voted, That Messrs. Varnum, Moore and Bowditch be a committee to petition the Legislature to restore the salary of the Secretary of the Board to the sum of twenty-five hundred dollars.

Messrs. Taft, Bird and Round were appointed a committee to report the names of five members to compose the Executive Committee for the ensuing year.

Voted, That the Executive Committee have power to change the day or days of holding fairs of any society for that year.

Messrs Hersey, Bowditch and Moore were appointed a Committee on Printing.

The committee on names to compose an executive committee reported Messrs. Wilder, Hadwen, Bowditch, Slade and Moore, who were accepted.

The Board then adjourned.

THIRD DAY.

The Board met at nine and a half o'clock, Mr. Grinnell in the chair.

Present: Messrs. Buell, Bowditch, Damon, Davis, Edson, Farnsworth, Fay, Grinnell, Goessman, Goodrich, Hadwen, Haskell, Hill, Hersey, Jewell, Lane, Lynde, McKinstry, Moore, Nye, Noble, Round, Slade, Sessions, Taft, Waterman, Ware, Warner, Wheeler and Wilder.

Dr. Nichols' report on the Middlesex Society was read by the Secretary; the reports on societies were then taken from the table, read by their titles and accepted; and the Secretary was ordered to print the report of Mr. Grinnell on the Nantucket Society.

The Committee on the Assignment of Delegates, reported as follows: —

Amesbury and Salisbury,	H. C. Haskell.
Barnstable,	D. Round.
Berkshire,	V. Taft.
Bristol,	H. Noble.
Deerfield Valley,	E. C. Farnsworth.
Essex,	A. A. Smith.
Franklin,	E. A. Davis.
Hampden,	John E. Russell.
Hampden East,	M. I. Wheeler.
Hampshire,	E. Hersey.
Hampshire, Franklin and Hampden,	D. E. Damon.
Highland,	W. R. Sessions.
Hingham,	G. Jewett.
Hoosac Valley,	S. B. Bird.
Housatonic,	C. L. Buell.
Marshfield,	W. L. Warner.

Martha's Vineyard,	J. S. GRINNELL.
Middlesex,	JOHN LANE.
Middlesex North,	J. P. LYNDE.
Middlesex South,	E H GOODRICH, JR.
Nantucket,	A. C. VARNUM.
Plymouth,	A. P. SLADE.
Union,	J. H. HILL.
Worcester,	BENJ. P. WARE.
Worcester North,	O. B. HADWEN.
Worcester North-West,	J. O. MCKINSTRY.
Worcester South,	J. BUDDINGTON.
Worcester South-East,	J. R. NICHOLS
Worcester West,	E. F. BOWDITCH.

The report was accepted.

Dr. Lynde, from the Committee on the Assignment of Subjects for Essays, reported as follows: —

"Fruits for the Orchard and Garden." J. H. Hill.
"How to Keep Boys on the Farm." J. B. Moore.
"Unimproved Lands of the Commonwealth." D. Round.
"Preparation of the Soil for the Growth of Crops." E. Hersey.
"Farm Fences." E. A. Davis.
"Corn Culture." H. C. Haskell.
"The Barn for the Farmer." J. Buddington.
"The Farmer's Home." W. L. Warner.

The report was accepted.

The Board then proceeded to the election of one of its members to the Board of Control of the Experiment Station. Dr. Lynde was elected.

Mr. HADWEN read an essay upon "Raising and Selecting Field and Garden Seeds."

RAISING AND SELECTING FIELD AND GARDEN SEEDS.

BY O. B. HADWEN OF WORCESTER.

Nothing can give the cultivator of the farm or garden greater satisfaction than the positive knowledge that he is planting good seeds, which are essentials to the success of good husbandry. To witness seed putting forth its germs containing the hidden forces of growth and harvest, knowing in advance the exact type of vegetable, fruit or flower to grow from the several kinds and strains of seed planted, to seek for and be able to comprehend and master the art of obtaining new hybrids and crosses of all vegetable growth, and perfect the desirable qualities of each, is in the power of the husbandman, and how it may be done is within the scope of the subject assigned to me.

At the same time this paper is by no means intended to go into a solution of so vast a subject, but can aim only at a few hints toward a solution.

Let us learn to do everything as well as we can, should ever be kept prominently in view, in "raising and selecting seeds." Nature does the work, matures and finishes every seed, perfect in form, size and color, containing germs to reproduce the vast variety of vegetation grown in all latitudes and climates the world over. The plant, leaf, flower and seed, are each exact types of their kind, unless changed by forces and conditions, which nature has provided to complete her charm. Nature's forces in seeds are susceptible to influences and conditions which are applied not only by nature herself but by art. Thus the pollen transferred from one flower to another of the same species will produce a seed containing a germ, which will be quite likely to produce a hybrid, blending the properties of each. When of the same variety it will reproduce its kind. Hence it is within the power and art of man to so act upon the forces of nature as to produce varieties of flowers, fruits and vegetables *ad libitum*. And it is by hybridization that we witness every year some new and desirable variety of vegetable or fruit which proves a desirable acquisition.

I have a friend who, by self-culture and ambition, has become thoroughly accomplished in the science and art of

raising and selecting seeds, whose habits of persevering industry seem interwoven in his very nature, whose fondness for the farm and garden, and his means, give him the opportunity of doing some intelligent and perfect work, whose practical results show the degree by which his accomplishments can be measured.

I was shown into the garden; my eye fell upon plat after plat of vegetables, of the highest degree of excellence, better than any I had ever seen; every sort seemed to indicate the highest cultivation, and true to a fixed type. I at once began inquiry as to the modes and practices to produce such results as were before me. "Raising and selecting seeds" proves to be one of the primary causes.

I will take for illustration his lettuce. He raised seed for eight or more consecutive years; first, by selecting twenty of the most promising heads, and out of the twenty one would be chosen, being the most perfect in form and substance, from which seed is gathered for the next season's planting, and by this course for a term of years lettuce is grown of rare excellence; large, compact heads of very great substance, as well as crisp and tender. Other garden vegetables are successfully grown, and seeds are raised and selected with even more care.

Strawberries grown from seed received special attention, and plants were wonderfully strong and productive, one hundred hills producing seventy-nine quarts in June, 1881, that were set out the previous August. We were shown plants standing alone, at long distances apart, which had received special fertilization by the pollen of the best known sorts, applied in the most scientific and careful manner. These seedling plants indicated not only a marked type, but a luxuriance and thrift such as I have never witnessed, and promise results which can be obtained only by the most careful and patient continuance in well-doing. My friend has demonstrated by repeated trial and experiment that potatoes of one variety can be made two weeks earlier, by selecting eyes from the seed end, or two weeks later by selecting eyes from the opposite end; by persisting and following out this practice for a term of years their maturity can be controlled; furthermore, that potatoes of one variety may be grown either

round or elongated by a careful selection of seed, indicating in a much greater degree the type desired. And while I can only describe but few things in the garden, the whole impressed me as work which can be accomplished only by nice selection of seed, and thorough cultivation, combined.

I have another friend who has a natural and perhaps an educated fondness for the farm and garden, whose fields show the influence of the thrifty hand, as wéll as a mind trained to their cultivation. The fields are tilled for the usual farm crop, where rotation is the course of husbandry pursued. Grass, corn, oats, barley, potatoes and roots are grown. The garden is planted with vegetables for the family sustenance, and the surplus finds sale among friends and the market.

The major portion of the seeds used are bought of the "reliable seedmen," — men who co-operate with the itinerant seed venders who, for money, sell seed with high sounding names, represented to be true to name and variety. Under these circumstances, while my friend sometimes gets good seeds, he often is doomed to disappointment in various ways during the season. The early dwarf peas, which he has made no provision to bush, he soon finds making a prodigious growth, and are in season with the Champions.

His early Egyptian beets (he was beat when the seed was bought) proved to be mixed in great variety, from the half-long red to the veritable mangold. His early sweet corn comes up Stowell's evergreen and other nameless sorts; his cabbages are as headless as the seed vender is heartless.

Amid his vexations he concludes that accomplishments contribute some happiness to life, and resolves in the future to raise his own seed, or to buy of those who make a specialty of raising the best.

It is rarely practical or good husbandry for the farmer to raise all the varieties of seeds he wants; he is rarely versed in the varied knowledge and conditions required to grow the many sorts; but he may make a specialty of a few, and learn and apply the principles to develop the best. A man who learns to do anything well enjoys his occupation, and is confident his labor will be rewarded with success.

If farmers would work to produce the best of one or

two sorts of seeds, ever keeping prominently in view the selection and all conditions required to grow them, and would exchange, buy or sell of others equally skilled in growing other sorts, very great advantage would be obtained; the farm crops would be vastly increased, and more profits and less disappointment would be their reward.

Every one is aware, who knows anything of farm products or of farm economy, that well grown and select seeds produce better and more remunerative crops than ordinary seeds. Good seed of all kinds contain strong germs, and the germs contain the forces transmitted from the plants, from which they have been grown.

Those who select fruits, vegetables or cereals for seed, know this; and consequently, nice discrimination is used in the selection. A sample—the standard of excellence of its type—should be kept constantly before the eye, as a test-guide to strict selection and foresight; "for as ye sow, so also shall ye reap" holds especially good in seed growing and planting.

In the selection of the cereals, and especially oats, rye, wheat and barley, sieves should be used, gauged to accurately measure every grain, that will assort and hold fast all that are good and reject those that are not well developed and up to the standard. Careful selection of seeds points strongly in the direction of maximum crops to the seed grower, and on his discriminating care depends his success.

There is a very wide and marked variation existing between plants and seeds of the original or wild types and those of the present high degree of excellence, produced by careful selection accompanied with high cultivation; for no well-bred seed will produce a maximum plant when but partially fed in an impoverished soil; neither will a poor seed produce a maximum plant in a generous soil. Hence good selection of seed and good cultivation should go together to develop the highest degree of excellence in plant-growth.

It is said there are about seventy species of vegetable seeds grown in the United States, and of the seventy species, there are upwards of four hundred varieties grown that

are catalogued by seedsmen, and perhaps nearly as many more of seeds of flowers; affording a field so vast in extent that I can designate by name but a few of the most important.

Concerning the cereals, much interest is manifest. In wheat, it is said, Mr. Hallett commenced the strain of his original pedigree wheat in 1857 by selecting an ear measuring four and three-quarters inches in length and containing forty-seven grains. In four years, by careful selection and cultivation, his finest ears measured eight and three-quarters inches in length, containing one hundred and twenty-three grains, being a gain of nearly twice the length of head, and more than twice the number of grains. The second year he obtained ten ears to the stool, and the fifth year of trial fifty-two ears to the stool; being a marked experiment in careful selection accompanied with good cultivation.

Perhaps no grain is grown upon a wider range of latitude or in greater variety than is corn. Corn of apparently the same variety differs under even slightly varying conditions; soil temperature, moisture and other influences tend to modify and change, to almost infinite variety. Many farms, where selection of seed and uniform cultivation are pursued, produce and develop distinct sorts, under conditions peculiar to each.

Oats and rye are equally susceptible to good husbandry and careful selection of seed.

But no more marked changes have occurred with the cereals than are apparent in the class of vegetables in use for domestic purposes and feeding animals. The potato, the *sine qua non* of the vegetables, grown in a latitude quite extensive, but favoring the northern and cooler sections of the country, within my recollection has been most wonderfully improved in quality, although diminishing in quantity of product.

In the retrospect of the potato culture, it would seem that different sorts have their day and generation, and then, from some cause not satisfactorily accounted for, seem to run out and disappear, although there are some exceptions; for example, the Shenango, or Mercer, so popular fifty years ago, is still successfully grown by some careful cultivators.

The tomato, within the last forty years, has perhaps under-

gone as many changes and been improved to as great an extent as any, and now, it would seem, has arrived almost to perfection when compared with the sorts formerly grown; but new ones are yearly exhibited, to have their place and generation, and then give way and place to the unborn.

Celery has been much improved by selection and cultivation within the last twenty-five years, and now several fine and quite distinct sorts are grown, varying in habit of growth, texture and flavor.

The squash has increased in variety and value as a culinary vegetable, within my recollection, to a wonderful degree, but unlike some other vegetables, the old crook-neck is still grown and esteemed, while those of more recent origin are largely grown and considered indispensable to good living; but every few years some new sorts appear, a little better or a little more desirable than the older, and must have their trial by jury without number.

The pea is now represented by a wonderful variety, embracing the Earlies, Mediums and Lates, either dwarf or giant in their habits of growth, distinct in flavor and tenderness, as well in size of pods and productiveness, and new sorts are catalogued annually by seedsmen.

The beet, it would seem, has almost, if not quite, arrived at an advanced state of perfection, not being as susceptible of variation as are some of the vegetables. It has undergone great improvement in form and color in the table sorts, and size in those fed for stock. The sorts grown and used in the manufacture of sugar now produce twice the amount of saccharine matter as formerly, and this is a marked instance of judicious selection of seed and cultivation.

The parsnip, although much improved from the wild state, and producing large crops, is still objectionable in form, and its long and tapering root renders it difficult and expensive to harvest. Whoever can produce the parsnip of the form approximating the intermediate carrot, would confer a great boon to its cultivation and value as a vegetable for both the table and stock.

The carrot in its great variety and its adaptability to yield to careful selection, would seem well fitted for its various uses.

The cabbage has proved susceptible of great change and is now cultivated in great variety, adapted to the conditions and use for man and beast. It will require very nice cultivation and selection to maintain its present excellence.

Among the fruits great changes in variety and quality are constantly going on, promoted by the ardent cultivators skilled in hybridization and development, and within our State some of the best apples, pears, peaches and grapes have been produced from seed that are now cultivated.

The smaller fruits have for a long time received the especial attention of horticulturists, and their variety is almost without number that are especially good and desirable. Hundreds of seedlings have been introduced in all parts of the country through the means of applied science, by almost as many different men; fruits that are suited to the diversified conditions of a vast extent of territory, densely populated.

Mankind is blest and favored by the skilful works of these men, I will say benefactors, of their race; originating and producing an abundance of delicious fruit within easy access, and moderate price, to the millions of consumers all over the country.

It is a fine art, as agriculturally and horticulturally practised, to produce and select seeds containing the germs of fruits and vegetables of delicious flavor, beautiul color and shapely form.

It is a fine art to transmit the pollen from flower to flower, to store in its seed the requisite force to produce flowers of the most exquisite and delicate tints and color, charmingly blended, differing from all ever heretofore produced, and to be commended and praised by generations of men.

It is a fine art to grow and select seeds for many consecutive years from the most select of vegetables, fruits, and flowers, seeds containing the inherent forces to reproduce the most perfect of its kind. Such talents have been given to man, to choose the most beautiful and best of nature's bounties; and "The end crowns the work," said the practical Romans.

We will conclude this paper,—

1. By recommending farmers and others to grow one or more kinds of seeds of the highest possible excellence.

2. To study the art of close selection of vegetables, fruits and flowers, from which seeds are desired to be grown.

3. To pursue the high order of cultivation requisite to develop the strongest and most perfect seeds.

The essay was discussed and accepted.

Adjourned for one hour.

The Board assembled at two o'clock, and heard Mr. Chamberlain upon "Insect Pests of the Cranberry Crop."

Voted, That the Secretary should present the matter to the Directors of the Experiment Station, and request them to report at the next annual meeting upon the habits of the insects that prey on the cranberry, and the methods of their destruction.

Mr. Blackwell had a hearing on cultivation of Sorghum. The subject was indefinitely postponed.

Mr. Fay's essay was taken from the table and discussed at length, Messrs. Wheeler, Sessions, Taft, Wilder, Moore and Slade taking part in it. The report was adopted and ordered to be printed, with some alterations, to which Mr. Fay agreed.

Mr. ROUND read a paper upon "The Army Worm," which was discussed and accepted.

REPORT ON THE ARMY WORM.

BY DANIEL ROUND, OF NANTUCKET.

Gentlemen of the Board of Agriculture:

I do not appear before you as a professor of entomology, or even as a very proficient amateur in the science of entomology. In the course of my study of agriculture it has been my aim to develop the best means to obtain good and perfect crops; to search for causes that produced or led to certain effects; and to find how best to prevent the evil, and to obtain the good. The number of insects known to be injurious to our crops is very great, and in the case of some of

them, a life of constant study, even if that life is prolonged to the allotted years of mankind is not sufficient to discover all that it seems desirable to know about them. Why they come and go as they do are mysteries, concerning which one generation may speculate, and leave for the next no conclusive results. The most we can do is by constant vigilance and investigation to make some progress towards the desired end.

The army worm has engaged the attention of entomologists for a great number of years, and thus far there is a striking similarity in the reports of their observations, and a general agreement as to the best means for destroying them. Upon some points there are conflicting opinions, but I fancy that much of this difference is the result of observations made in different places, and under different climatic influences. It will be my object in this paper to collect together the results of my personal observations and such facts as entomologists who have had better opportunities for critical examinations have within a few years published for the information of agriculturists generally. In doing this, I shall, as far as possible, avoid technicalities and scientific terms not easily comprehended by the ordinary farmer. My attention was especially called to this subject by an article in a copy of the "Boston Journal" published last summer, in which was the statement that the first appearance, so far as noted, of the army worms was upon the same farm upon which they first appeared in 1861. It seemed to me that this statement, if it proved, indeed, to be true, might lead to the development of some definite conclusions in relation to this mysterious destroyer. I deemed it of sufficient importance to communicate my convictions to the Secretary of the State Board, and by him I was requested to investigate as far as my other engagements would permit and forward to him the results. As soon after as I could spare the necessary time, I visited Newport and Portsmouth, R. I., and some of the southern parts of Massachusetts, and by conversation with the farmers who had suffered by the depredation of the worms, and personally visiting the fields upon which they appeared in large numbers, noted such facts as seemed to me important in reaching the conclusions to which I shall call

attention in this paper. I also communicated with Prof. Packard, and by him was referred to Prof. Riley, the United States entomologist, and from him I received advanced sheets of his forthcoming report upon the army worm, together with the report of Prof. Thomas, the State entomologist of Illinois, for 1881. From these sources and the writings of several modern authors upon the subject, I have, after patient thought, deduced the following facts and conclusions.

That, while the army worm has no stated periods for its migratory habits, it is always to be found, especially in the low lands, and along the borders of fields bordering upon the low lands. When thus found in what appears to be its normal state, its habits are like the cut-worm with which we are all familiar; and here, as peradventure some may wish to search for it, I will transcribe a brief description of its several stages of development, in which all writers essentially agree. The army worm moth is a night-flying moth of a yellowish drab color inclining to russet, some say a fawn color, with a small white dot near the centre of its forewings and a dusky, oblique stripe at their tips; rather less than an inch long to the end of its closed wings, and about an inch and three-quarters in width when the wings are extended. Mr. Treat, in his recent work published by Orange Judd & Co., says the eggs are laid in the spring of the year, which is in accordance with the opinions of Riley, Thomas, and other entomologists. Prof. Riley, to whom belongs the credit of actual observation, says the eggs are deposited in the terminal leaves of grass or grain near its connection with the stalk, and are smooth, opaque white, and covered with a glistening adhesive fluid, and Prof. Comstock says they are laid in strings or rows of fifteen, twenty, or more. The time to search for the eggs is in March or April, the time varying according as the season is early or late. The time required for the eggs to hatch is about two weeks; if the season should be very warm they may hatch two or three days sooner. The worms when first hatched are white, head large and uniformly black; loops and spins a web, and drops at the least disturbance. In its second stage, it still loops and drops by means of a web; the color of the head is

changed to copal yellow and the body to a yellowish green; the lines of the mature larvæ begin to appear in a faint rose-brown color. In the third stage the lines become more distinct and the looping habit is lost. From this stage to the mature larvæ the lines become more distinct and answers the general description given by Harris and others, and is about one and one-half inches long, of a dingy black color, with broad, dusky stripes along the back divided along the middle by a more or less distinct and irregular pale line bordered beneath by a narrow black line; then a narrow white line; then a yellowish stripe, etc. This description of the larvæ will be sufficiently minute for the casual observer, and is made up of those given by several writers. The larvæ state lasts about four weeks, when they descend into the ground a few inches below the surface, where they are transformed into a pupa or chrysalis state. The chrysalis is of a mahogany color, about three-quarters of an inch in length. In searching for the eggs or the worms in the early stages of their growth, it will be well to look among the tufts of coarse grass in the lowlands or grass of a rank growth around the droppings of cattle early in the spring. The second important consideration, is the fact that the season before the appearance of the army worm with migratory habits has universally been very dry, and the early spring following wet enough to give vegetation a good start.

How far this consideration will go in determining the time to look for the depredations of our fields of grain and grass by this pest under marching orders, I am not quite clear, for wet springs have frequently followed a dry summer the preceding year and no great injury has been done by the army worm. The mystery is but partially solved, and I would suggest (with the risk of being considered visionary) that as various kinds of insects seem to have given them premonitions of storms and wisdom to prepare for them, so may not the approach of a second dry summer cause the army worm to forage for the time of need. The summer of 1881 was very dry, where the worms first appeared in this section of the United States, and was followed in 1882 by similar climatic influences, and as near as I can remember the same conditions existed in 1860 and 1861, the spring of

1861 being as in 1882. And may it not be laid down as a rule that when one dry summer follows another with a wet spring preceding the second, the army worms will become migratory and so far forsake their normal habits. One point in the consideration of this subject seems to be well established by the most distinguished entomologists—that climatic influences have much to do with the migratory habits of this pest; but no definite conditions have been laid down for its certain appearance.

In its normal condition the army worm is found in the low, moist lands and on the borders of swamps, where the grass is rank and coarse. I took special pains in my investigations last summer to look for these conditions, and in no case failed to find them; that is, bordering every field upon which the worms appeared in great numbers last summer, was low or swampy land, and I universally received from those who suffered by the worms, an affirmative answer to the question, "Was there near or bordering on your fields upon which the army worm appeared, low or swampy lands?" It seems, too, that, by some means of knowledge that to us is unknown, no matter where upon the uplands the worm reaches the end of its larvæ state and enters the earth to form its chrysalis, the moth that comes from the chrysalis at once seeks the low land from which the worm or larvæ came, and makes that its favorite home in which to raise up other generations of its kind.

To this habit may be attributed the fact that the army worms appeared first in 1882 upon the same farms in this State upon which they were first observed in 1861; and, wherever the conditions as to cultivation were similar, they appeared first upon the same fields, and their line of march was in the same direction. It has been stated by entomologists, that the worms, in their first stages of growth, have been found on all parts of fields of grain at the same time; hence the eggs must have been deposited by the moths upon the leaves of the growing grain. This may be true when such fields bordered upon the low lands, which, as we have stated, were the natural homes of the army worms; but I think not otherwise And may not this lead us, with good reason, to conclude that the moths were endowed with some

mysterious instinct to convey the order for marching, else why have fields been left untouched by them for so many years, only to forsake their normal habits, for reasons that we can only conjecture, after so long periods of time? The theory that climatic influences determine the years when the army worm will become migratory is a good one; but there are questions unanswered as to how such influences operate to change them from their normal state and determine them to migrate, and what inducements are presented by heat or cold, a wet or a dry season, to cause them to move to other lands for food than those upon which they have remained for years. The means for destroying them suggested by different writers are, perhaps, as good as any that I can recommend,—such as ploughing deep furrows and making the side of the furrow towards the field to be protected perpendicular, and digging deep holes about fifty feet apart in the furrow, so that the worms, failing to climb the perpendicular side and moving along to find a better place to get over, fall into the holes, in which they can easily be destroyed by pouring kerosene upon them and burning them. Some recommend rolling the field upon which the worms are found; but this method of destruction is by no means certain, as many will escape. Paris green and London purple have also been used quite successfully. Harris recommends that the hogs be turned in upon them as soon as the crop is removed, but I fail to see the benefit when the worms have gone on, as they must have done, to other fields, and there is no certainty that they will come again for years. He also recommends that the chickens, turkeys and ducks be turned in upon them. These will help to destroy them, but will not exterminate them. The ploughing of furrows, as already described, is the most sure means to stop them in their march and save other fields from their depredations. It has also been recommended to burn over the fields in the fall of the year, so as to destroy the old stubble and tufts of grass, etc., which recommendation I should approve, for it may destroy some of the eggs and larvæ of the army worm, and most certainly will destroy the pupa and larvæ of other insects injurious to vegetation. But Prof. Riley's advice to burn over the fields in the early spring is certainly more

sensible and will prove more effectual, and if farmers generally would take more pains to rake up clean the refuse straw where grain has been shocked or stacked, and all loose waste material, such as weeds, corn-stalks, and leaves of every kind, and burn them, they would have less trouble with insects in the spring and summer.

Finally, as to means for destroying the army worms, my opinion is that first by observing the presumptive climatic influences which, according to the writings of the most distinguished entomologists, have preceded their appearance with migratory habits, and then, in the early spring, examining the coarse tufts of grass, especially near to the low lands, or the stubble upon last year's grain-fields, especially on the sides nearest to the low lands, and the coarse bunches of grass that grow around the droppings of the cattle. If the eggs are found in considerable quantities, or if towards evening, or after dark, by the aid of a lantern, the moths are seen in great abundance, the presumption is that an invasion is threatened, and much of the evil can be avoided by burning, where it can be done; or by an application of a solution of Paris green or London purple, if there is no danger to fowls or animals, and the preparation of furrows as before described.

I would also recommend the burning of heaps of rubbish, just at night, wherever the moths are seen in great numbers, or even if not very plenty; for the destruction of the moths will prevent the deposit of eggs, and consequently the hatching of an army of the worms. It is my opinion that only in the spring of those years when the worms are to become migratory, will any considerable number be found away from those places where, in their normal condition, they are always to be found by persons who are acquainted with their habits.

I have intentionally made use of the term presumptive climatic influences, because, while I am convinced that a dry summer, followed by a spring sufficiently wet for a vigorous start for vegetation, will be favorable conditions for the appearance of the army worm in this State, I find that the conditions are by no means uniform in all parts of the United States, except that in nearly every case some part of the summer preceding their appearance has been very dry. That climatic influences certainly precede and accompany

the migratory habits of the army worms I have no doubt, but up to this time no one has been able, with certainty, to define these influences with sufficient clearness to determine exactly when to look for the invading foe.

In conclusion, after days of reading and study and carefully weighing the opinions of those who, from education and careful observation, have deduced theories that I am neither able to overturn or substitute with better ones, I am beset with mental queries like these: By what order of climatic changes is the normal condition of the army worm changed? Why does it increase so much more in its abnormal condition than in its normal condition? Why, after a year of such great increase, does it seem to disappear, or so far disappear as not to be observed as the destroyer of crops for a number of years? When it reaches the end of its larva state, on its march in such immense numbers, what becomes of it? If it becomes a chrysalis and hybernates as a chrysalis, why does it not begin the next season as a moth in the same place, and, having deposited eggs for an army greatly increased, what becomes of it? Perhaps not one can be found on that field or even on the farm of which that field is a part. Solomon has said that "there are times and seasons for all things," but the times and seasons for the appearance of the army worms have not yet been defined with absolute certainty. Finally, I commend the very interesting report of Prof. Riley upon the army worm, printed in in the forthcoming reports of the United States Agricultural Department. Prof. Riley, in his report, has carefully considered the opinions of others who have made investigations upon this subject, and, with the reports of correspondents from all parts of the country where the army worm has appeared, and his own personal investigations, has condensed about all that is really yet known in regard to this — at times — great destroyer. In the times when the Pharaohs governed Egypt, the frogs and lice came up and covered the whole land; in the subsequent history of the children of Israel, their prophets mention the locusts, the canker worm, and the palmer worm that appeared at irregular periods, and destroyed their crop. And, from the scattering of Israel till this time, history records the unexpected and unex-

plained advent of armies of insect-destroyers; and while entomologists have classified them, and described them in all their stages of development, no reliable theory has been given for their coming and going, in such immense numbers and at irregular times.

The Board then adjourned.

FOURTH DAY.

The Board met at half-past nine o'clock, Mr. GRINNELL in the chair.

Present: Messrs. Buell, Bowditch, Damon, Davis, Edson, Farnsworth, Grinnell, Goodrich, Hadwen, Haskell, Hill, Hersey, Lane, Lynde, Moore, Nye, Noble, Round, Slade, Sessions, Taft, Waterman, Ware, Warner and Wheeler.

Voted, That an act to establish an Agricultural Experiment Station, chap. 212, sect. 3, of the year 1882, be amended in the third line after the word legislature, by inserting the words, "and the State Board of Agriculture," and that the Secretary be instructed to have the same brought before the legislature, and urge its adoption before the committee to which it may be referred.

Prof. GOESSMANN, State Inspector of Fertilizers, submitted his Tenth Annual Report.

TENTH ANNUAL REPORT ON COMMERCIAL FERTILIZERS.

BY PROFESSOR C. A. GOESSMANN, STATE INSPECTOR OF FERTILIZERS.

GENTLEMEN: — The trade in commercial fertilizers has been quite active during the past year. A larger number of manufacturers have entered our markets, in the western and central portion of the State in particular, than in preceding years. The character of the leading standard fertilizers has been but little changed. Wherever changes have been made the tendency has been to increase the potash and to decrease the nitrogen. The stock of fertilizers carried over from 1881 to 1882 was quite large, on account of unsatisfactory crops in the South. As the prices of 1881 were exceptionally high, similar high prices ruled during the spring of 1882. As the spring trade furnishes by far the larger amount of fertilizer used in the State, the retail prices of my previous report (ninth) have been retained in the valuation of all articles mentioned in the present report.

	Price per pound, in cents.
Nitrogen. In form of nitric acid,	25
In form of ammonia,	26
In form of dried ground meat and blood, finely-pulverized steamed bones, finely-ground fish-guano, Peruvian guano, urates, poudrettes, and artificial guano,	24
In form of finely-ground bones and bat-guano,	22
In form of fine-ground horn, wool-dust, etc.,	15
In form of horn-shavings and woollen rags, human excretions and barnyard-manure, fish-scraps, animal refuse, matter from glue factories and tanneries, etc.,	12
Phosphoric Acid soluble in water. As contained in alkaline phosphates and superphosphates,	12.5
In Peruvian guano and urates,	9
In form of so-called reduced or reverted acid,	9
In precipitated bone-phosphate, steamed fine bones, fish-guano, according to size and disintegration, from	6 to 8
In form of bone-black waste, wood-ash, Carribean guano, ground-bone ash, coarsely-ground bones, poudrette, barnyard-manure, etc.,	4
In form of finely-ground South Carolina and Navassa phosphates,	3
Potassium Oxide. In form of muriate of potash or chloride of potassium,	5
In form of sulphate of potassa in natural and artificial kainits,	5
In form of higher grades of sulphate of potassa,	7 to 7.5

Some reduction in prices is to be expected for the coming season, on account of a decided decline in some of the leading articles of the crude stock of fertilizers. A statement of the late wholesale prices in the Boston and New York markets accompanies these pages. An addition of twenty per cent. to the wholesale price approximates the customary retail charges. A late attempt to introduce ground leather refuse as a nitrogen source into ammoniated superphosphates deserves the serious attention of the Board. Whilst it remains very desirable that all suitable nitrogen-containing refuse material from our various industries should be economized for manurial purposes, it remains not less justifiable to restrict manufacturers in the use of articles of doubtful merits without giving due notice of the fact.

Wholesale Prices, New York and Boston, of the Year 1882.

Name of Material.	Price per ton of 2,000 pounds, in dollars.
Sulphate of Ammonia, containing from 24 to 25 per cent. of ammonia,	85–95
Nitrate of Soda (Chili saltpetre), containing 95 per cent. of that compound,	54–60
Nitrate of Potassa, containing 94 to 96 per cent. of that compound,	165–170
Dried Blood, yielding from: —	
(a) 15 to 17 per cent. of ammonia (black),	54–60
(b) 12 to 14 per cent. of ammonia (soft red),	40–47
(c) 10 to 12 per cent. of ammonia,	34–40
Dried Meat, yielding from 14 to 15 per cent. of ammonia,	50–55
Castor Pomace (ground), yielding 6 to 7 per cent. of ammonia,	24–28
Cotton-seed Meal, yielding 7 to 8 per cent. of ammonia,	28–30
Fine-ground Bones (steamed), yielding from 3.5 to 4.5 per cent. of ammonia, and containing from 50 to 55 per cent. of bone-phosphate,	38–45
Bone-black (waste material), containing from 30 to 34 per cent. of phosphoric acid,	30–33
South Carolina Phosphate (ground), containing from 25 to 28 per cent. of phosphoric acid,	18–22
Navassa Phosphate (ground), containing from 25 to 28 per cent. of phosphoric acid,	20–25
Canadian Apatite (ground), containing from 30 to 35 per cent. of phosphoric acid,	25
No. 2 Superphosphate of Lime, containing from 15 to 16 per cent. of soluble phosphoric acid,	29–32

Name of Material.	Price per ton of 2,000 pounds, in dollars.
Acid Phosphate, containing from 12 to 14 per cent. of soluble phosphoric acid,	25–28
Lobos Guano, yielding from 4 to 6 per cent. of ammonia, and containing from 18 to 20 per cent. of phosphoric acid,	55–60
Peruvian Guano (guaranteed), yielding from 6 to 8 per cent. of ammonia, and containing from 12 to 14 per cent. of phosphoric acid,	60–65
Muriate of Potash, containing from 80 to 85 per cent. of that compound, equal to from 50 to 53.7 per cent. of potassium oxide,	36–40
Muriate of Potash (Doughlasshall), containing 80 per cent. of that compound, equal to 50 per cent. of potassium oxide, and about 10 per cent. of sulphate of magnesia,	40–45
Sulphate of Potassa, containing 80 per cent. of that compound, which is equal to 43.3 per cent. of potassium oxide,	60–65
Sulphate of Potassa, containing from 60 to 65 per cent. of that compound, which is equal to 32.3 to 35 per cent. of potassium oxide,	40–45
German Potash Salt, containing from 28 to 32 per cent. of sulphate of potassa, which is equal to from 15 to 17.3 per cent. of potassium oxide,	18–20
Kainit (low grade), containing 22 to 26 per cent. of sulphate of potassa, which is equal to 11.9 to 14 per cent. of potassium oxide,	9–12
Sulphate of Magnesia (Kieserite), containing from 60 to 70 per cent. of that compound,	18–22
Sulphate of Magnesia, containing from 50 to 55 per cent. of that compound,	14–15
Fine-ground Gypsum, containing from 95 to 98 per cent. of that compound,	9–10

Muriate of Potash.

(W. H. Earle, Worcester, Mass.)

	Per cent.
Moisture,	2.15
Potassium oxide,	50.25
Sodium oxide,	11.26
Magnesium oxide,	0.90
Sulphuric acid,	0.50
Calcium oxide,	Trace

This potash compound is more and more used as a potassa source in field and garden cultivation.

Magnesia-Potash Sulphate.

(Collected of Wm. H. Earle, Worcester, Mass.)

	Per cent.
Moisture,	4.00
Potassium sulphate,	51.30
Potassium oxide,	27 77
Magnesium oxide,	12.30
Magnesium sulphate,	36.90
Sulphuric acid,	47.90
Insoluble matter,	1.18

The consumption of this saline is apparently increasing; for tobacco and deep-rooting plants, it deserves a fair trial.

Canada Ashes.

(Messrs. Horton & Phelps, Northampton.)

I.

	Per cent.
Moisture,	23.24
Organic and volatile matter,	32.95
Ash constituents,	67.05
Phosphoric acid,	1.01
Calcium oxide,	32.27
Potassium oxide,	3 55
Insoluble matter,	8.26

II.

Moisture,	8.40
Organic and volatile matter,	20 66
Ash constituents,	79.34
Phosphoric acid,	0.88
Calcium oxide,	39.71
Potassium oxide,	4.95
Insoluble matter,	6.64

These two samples (I. and II.) are fair specimens of the Canada ash sold in western Massachusetts; the price in car-loads of 600 to 675 bushels, is reported to be 34 cents per bushel.

III.

(Sent from Whately, Mass.)

	Per cent.
Moisture,	28.04
Organic and volatile matter,	39.62
Ash constituents,	60.38
Phosphoric acid,	0.68

	Per cent.
Calcium oxide,	34.43
Potassium oxide,	2.49
Insoluble matter,	3.35

This sample is less valuable than the previous sample; it is desirable that wood-ash should be sold by an analysis.

IV.

Ashes.

(Sent on for examination from Concord.)

	Per cent.
Moisture,	1.59
Organic and volatile matter,	29.50
Ash constituents,	70.50
Potassium oxide,	0.25
Ferric oxide,	Traces
Phosphoric oxide.	Traces
Calcium oxide,	18.00
Insoluble matter,	36.02

The composition of this article (IV.) corresponds more with that of a leached wood-ash.

Soot.

(Sent on for examination from Concord.)

	Per cent.
Moisture,	5.54
Organic and volatile matter (not moisture),	16.36
Ash constituents,	78.10
Potassium oxide,	1.83
Ferric oxide,	Traces.
Insoluble matter,	35.34

The source of this material was not stated; the large percentage of insoluble matter, and the small percentage of potassium oxide point toward coal-ash as the principal constituent of the article.

Onondaga Gypsum.

(Sheldon & Newcombe, Greenfield.)

	Per cent.
Moisture,	9.85
Calcium oxide,	30.14
Sulphuric acid,	32.69
Magnesium oxide,	6.06
Chlorine,	0.33
Insoluble matter,	8.28

This variety of gypsum has been of late largely sold in the western and central part of the State. It is well spoken of by those who have used it; its cost — six dollars per ton of 2,000 pounds — compares well with that of Nova-Scotia gypsum.

Green-Mountain Odorless Fertilizer.

(George W. Maynard, General Agent, Lawrence. Sent on from Secretary Russell.)

	Per cent.
Moisture at 100° C.,	14.24
Moisture at red heat,	18.72
Sulphuric acid,	2 62
Calcium oxide,	40.32
Chlorine,	7.87
Potassium oxide,	1.87
Phosphoric acid,	Trace.
Insoluble matter,	4.98
Ferric oxide,	Trace.
Sodium oxide,	6.83

The manufacturer of this article states that salt, wood-ash and burnt lime, mixed in certain proportions, and after a manner of his own, constitute the principal ingredients of it. The analysis apparently confirms this statement.

South Carolina Phosphate.

(Sent on for examination from Boston.)

	Per cent.
Moisture,	1 20
Loss by calcination,	3.48
Total phosphoric acid,	28.69
Insoluble matter,	9.18

This sample represents a high grade article of its kind.

Apatite (Canada).

(Sent on for examination.)

	Per cent.
Phosphoric acid,	37.32
Calcium oxide,	55.35
Chlorine, insoluble matter,	–

This specimen is rather of an exceptional character. The apatite obtained in Canada, and offered for sale to phosphate manufacturers, is more or less associated with silicous rocks, and quite difficult to pulverize.

English Superphosphate.

(Sent on from New York.)

	Per cent.
Moisture,	18.32
Volatile and organic matter,	–
Total phosphoric acid,	13.12
Soluble phosphoric acid,	8.54
Reverted phosphoric acid,	0.64
Insoluble phosphoric acid,	3.94
Potassium oxide,	1.72
Insoluble matter,	9.58

Valuation per ton of two thousand pounds: —

170.8 pounds of soluble phosphoric acid,	$21 35
12.8 pounds of reverted phosphoric acid,	1 15
78.8 pounds of insoluble phosphoric acid,	4 73
34.4 pounds of potassium oxide,	1 72
	$28 95

Ground Fertilizing Bone.

(O. H. Leach & Co., Boston, Mass.)

	Per cent.
Moisture,	3.93
Organic and volatile matter,	62 75
Ash constituents,	37.25
Total phosphoric acid,	18.58
Nitrogen,	2.37
Insoluble matter,	0.43

L. B. Darling & Co., Bones. (Ground Bones.)

(Collected by Messrs. Parker & Gannett, Boston.)

	Per cent.
Moisture,	7.83
Organic and volatile matter,	42.63
Ash constituents,	57.37
Total phosphoric acid,	22.16
Total nitrogen,	3.29
Insoluble matter,	0.29

Bone Fertilizer. (Bone Factory, Holyoke, Mass.)

(Collected by Messrs. Wilder & Puffer, Springfield.)

	Per cent.
Moisture,	7.10
Organic and volatile matter,	37.84
Ash constituents,	62.16
Total phosphoric acid,	24.56
Total nitrogen,	3.13
Insoluble matter,	0.20

Ground Bones.

(C. T. Brown, Northampton, Mass.)

	Per cent.
Moisture,	6.91
Organic and volatile matter,	49.35
Ash constituents,	50.65
Phosphoric acid,	19.40
Nitrogen,	3.71
Insoluble matter,	1.07

Ground Bones.

(C. W. Belknap & Son, Portland, Me.; collected by Rice Brothers, Worcester, Mass.)

	Per cent.
Moisture,	8.23
Organic and volatile matter,	43.05
Ash constituents,	56.95
Phosphoric acid,	18 37
Nitrogen,	2.71
Insoluble matter,	1.48

Raw Ground Bones.

(E. H. Smith, Northborough, Mass.)

	Per cent.
Moisture at 100°,	7.91
Ash constituents,	50.73
Volatile and organic matter,	49.27
Phosphoric acid,	21.82
Nitrogen,	3.68
Insoluble matter,	1.33

Pure Fish Guano.

(Quinnipiac Company, New Haven, Conn.; collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture,	37.06
Organic and volatile matter,	83.13
Ash constituents,	16.87
Phosphoric acid,	6.14
Nitrogen,	5.39
Insoluble matter,	1.62

Valuation per ton of two thousand pounds: —

122.8 pounds of phosphoric acid,	$7 37
107.8 pounds of nitrogen,	25 87
	$33 24

Bradley Fertilizer Company.

(Dry fish; collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture,	25.80
Organic and volatile matter,	83.09
Ash constituents,	16.91
Phosphoric acid,	5.60
Nitrogen,	6.80

Valuation per ton of two thousand pounds: —

112 pounds of phosphoric acid,	$6 72
136 pounds of nitrogen,	32 64
	$39 36

Bowker's Dry Fish.

(Collected of C. T. Brown, Northampton, Mass.)

	Per cent.
Moisture,	7.55
Organic and volatile matter,	81.80
Ash constituents,	18.20
Phosphoric acid,	7.54
Nitrogen,	9.62
Insoluble matter,	1.65

Valuation per ton of two thousand pounds: —

150.8 pounds of phosphoric acid,	$9 04
192.4 pounds of nitrogen,	46 18
	$55 22

Pure Dry Fish.

(Geo. W. Miles & Co.; collected of D. W. Dwight, Northampton, Mass.)

	Per cent.
Moisture,	19.88
Organic and volatile matter,	63.76
Ash constituents,	36.24
Phosphoric acid,	7.90
Nitrogen,	4.89
Bone phosphate of lime,	17.25
Insoluble matter,	1.56

Valuation per ton of two thousand pounds: —

158.0 pounds of phosphoric acid,	$9 48
97.8 pounds of nitrogen,	23 47
	$32 95

Codfish Guano.

(Bonne Esperance, Labrador; by W. H. Whiteley, St. John's, Newfoundland.)

	Per cent.
Moisture,	8.50
Organic and volatile matter,	27.77
Ash constituents,	72.23
Total phosphoric acid,	11.26
Soluble phosphoric acid,	.64
Reverted phosphoric acid,	3.46
Insoluble phosphoric acid,	7.16
Nitrogen,	7.09
Insoluble matter,	1.25
Fat,	4.60

Valuation per ton of two thousand pounds: —

12.8 pounds of soluble phosphoric acid,	$1 60
69.2 pounds of reverted phosphoric acid,	6 23
143 2 pounds of insoluble phosphoric acid,	8 59
141.8 pounds of nitrogen,	33 03
	$49 45

The heads, entrails, and back bones of the codfish are placed in iron kettles and boiled until they become a soft mass, which is subsequently pressed and dried in the air. The factory is capable of producing annually one thousand tons of dried codfish offal for the market, of the above composition.

Fish and Potash.

I.

(Geo. W. Miles Co.; collected of D. W. Dwight, Northampton, Mass.)

	Per cent.
Moisture,	19.85
Organic and volatile matter,	60.20
Ash constituents,	39.80
Total phosphoric acid,	5.26
Soluble phosphoric acid,	3.20
Reverted phosphoric acid,	1.09
Insoluble phosphoric acid,	.97
Nitrogen,	3.16
Potassium oxide,	3.82
Insoluble matter,	2.31

Valuation per ton of two thousand pounds: —

	Per cent.
64.0 pounds of soluble phosphoric acid,	$8 00
21.8 pounds of reverted phosphoric acid,	1 96
19.4 pounds of insoluble phosphoric acid,	1 16
63 2 pounds of nitrogen,	15 17
76.4 pounds of potassium oxide,	3 82
	$30 11

Fish and Potash.

II.

(Quinnipiac Co.; collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture,	16.76
Total phosphoric acid,	7.59
Soluble phosphoric acid,	.38
Reverted phosphoric acid,	1 41
Insoluble phosphoric acid,	5.80
Nitrogen,	2.70
Potassium oxide,	5.14
Insoluble matter,	2.00

Valuation per ton of two thousand pounds: —

7.6 pounds of soluble phosphoric acid,	$0 95
28.2 pounds of reverted phosphoric acid,	2 54
116.0 pounds of insoluble phosphoric acid,	6 96
54.0 pounds of nitrogen,	12 96
102.8 pounds of potassium oxide,	5 14
	$28 55

I.

Fish and Potash.

(Quinnipiac Company, New Haven, Conn.; collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture,	19.34
Organic and volatile matter,	–
Ash constituents,	–
Total phosphoric acid,	8.10
Available phosphoric acid,	5.82
Insoluble phosphoric acid,	2.28
Nitrogen,	3.59
Potassium oxide,	3.83
Insoluble matter,	2.12

Valuation per ton of two thousand pounds: —

116.4 pounds of available phosphoric acid,	$10 48
45.6 pounds of insoluble phosphoric acid,	2 74
71.8 pounds of nitrogen,	17 23
76.6 pounds of potassium oxide,	3 83
	$34 28

Horsefeet Guano.

(Earle Phosphate Company, Providence, R. I.; sent on by George T. Holmes, Attleborough, Mass.

	Per cent.
Moisture,	16.40
Organic and volatile matter,	49.92
Ash constituents,	50 08
Total phosphoric acid,	6.05
Nitrogen,	2.78
Potassium oxide,	.70
Calcium oxide,	5.07
Insoluble matter,	23.15

Valuation per ton of two thousand pounds: —

121.0 pounds of total phosphoric acid,	$7 26
55.6 pounds of nitrogen,	13 35
14.0 pounds of potassium oxide,	70
	$21 31

Peruvian Guano.

(Sent on for examination from New York.)

	Per cent.
Moisture,	16.54
Organic and volatile matter,	36.08
Ash constituents,	63.92
Total phosphoric acid,	16.46
Soluble phosphoric acid,	3.50
Reverted phosphoric acid,	.72
Insoluble phosphoric acid,	12.24
Nitrogen,	5.36
Insoluble matter,	20.43
Potassium oxide,	1.02

Valuation per ton of two thousand pounds: —

70.0 pounds of soluble phosphoric acid,	$8 75
14.4 pounds of reverted phosphoric acid,	1 30
244.8 pounds of insoluble phosphoric acid,	14 69
107.2 pounds of nitrogen,	25 73
20.4 pounds of potassium oxide,	1 02
	$51 49

Peruvian Guano. (Guaranteed.)

(C. T. Brown, Northampton, Mass.)

	Per cent.
Moisture,	15.39
Organic and volatile matter,	45.12
Ash constituents,	54.88
Total phosphoric acid,	18.39
Soluble phosphoric acid,	1.92
Reverted phosphoric acid,	6 19
Insoluble phosphoric acid,	10.28
Nitrogen,	5.20
Potassium oxide,	3.71
Insoluble matter,	3.55

Valuation per ton of two thousand pounds: —

38.4 pounds of soluble phosphoric acid,	$4 80
123.8 pounds of reverted phosphoric acid,	11 14
205.6 pounds of insoluble phosphoric acid,	12 34
104.0 pounds of nitrogen,	24 96
74.2 pounds of potassium oxide,	3 71
	$56 95

Wool Waste.

(Sent on for examination from Clinton, Mass.)

	Per cent.
Moisture,	2.75
Organic and volatile matter,	36.94
Ash constituents,	63.06
Nitrogen (15 cents per pound),	3.76
Potassium oxide,	3.48
Phosphoric acid,	Trace.
Insoluble matter,	42 33

Valuation per ton of two thousand pounds: —

75.2 pounds of nitrogen (15 cents per pound),	$11 28
69.6 pounds of potassium oxide,	3 48
	$14 76

The comparatively large percentage of potassium oxide in the raw wool waste imparts an additional manurial value to it.

Ammonium Sulphate.

(Collected of C. T. Brown, Northampton, Mass.)

	Per cent.
Ammonia,	24.70

Chemically Prepared Leather Refuse.

(Sent on from Boston, Mass.)

	Per cent.
Moisture at 100° C.,	8.00
Nitrogen,	8.50
Ash constituents,	.78

The substance was well ground, and of a dark brown color, similar to dried blood. Five hundred parts of water abstracted, at 18° to 20° C., 6.09 parts of soluble matter. The dissolved mass contained but traces of nitrogenous material. Heated with water to the boiling point it became soft like rubber, and turned brittle again after cooling. The above sample was sent on by a Boston manufacturer of fertilizers, accompanied by a statement that it was obtained from a party in Worcester, and was offered in the early part of the season at $5.50 per ton in Boston; its price had advanced in the month of May to fifteen dollars per ton. The material consisted of leather scraps which apparently had been treated with high-pressed steam for the abstraction of fat, and was thereby altered into a semi-carbonized or crispy mass. Judging from a series of samples subsequently received through the Secretary of the Board, its nitrogen percentage varies from 5.89 to 8.50. (See First Report of Agric. Experiment Stat., 1882.)

The low price of this animal refuse matter as compared with that of dried blood, ground meat, etc., has evidently served as an incentive to use it in place of the latter, as a nitrogen source in the manufacture of fertilizers. I am informed that from four to five thousand tons of this substance have been sold in and about Boston for that purpose during the past year. Baltimore is mentioned as a consumer in former years. As actual experiments in the field tend to prove that merely ground-up leather refuse of any description is even inferior in its action as a nitrogen source, on plant-growth, to horn shavings, it seems advisable in the interest of farmers and of manufacturers of fertilizers, not only to discourage its use, but to restrict, as far as practicable, its introduction as a nitrogen source into the important class of fertilizers commonly known as "Ammoniated Phosphates," by obliging the manufacturer to make known, in some conspicuous

manner to the consumer, that leather refuse has been used for the above purpose in the compounding of the article offered for sale. To use ground leather refuse as a nitrogen source in commercial fertilizers, without due notice to the farming community, ought to be treated as a fraudulent transaction, until some efficient preparatory treatment has been found by which its nitrogen may be rendered available.

E. Frank Coe's Ammoniated Bone Superphosphate.

(Collected of J. Clark & Son, Worcester, Mass.)

	Per cent.
Moisture,	22.20
Total phosphoric acid,	11.01
Soluble phosphoric acid,	8.06
Reverted phosphoric acid,	1.20
Insoluble phosphoric acid,	1.75
Nitrogen,	2.84
Potassium oxide,	1.39
Insoluble matter,	.76

Valuation per ton of two thousand pounds : —

161.2 pounds of soluble phosphoric acid,	$20 15
24.0 pounds of reverted phosphoric acid,	2 16
35.0 pounds of insoluble phosphoric acid,	2 10
56.8 pounds of nitrogen,	13 63
27.8 pounds of potassium oxide,	1 39
	$39 43

Common-Sense Fertilizer.

(Sent on for examination by Messrs. Sheldon & Newcomb, Greenfield, Mass.)

	Per cent.
Moisture,	14.14
Organic and volatile matter,	44.62
Ash constituents,	55.38
Total phosphoric acid,	4.50
Soluble phosphoric acid,	1.17
Reverted phosphoric acid,	2.03
Insoluble phosphoric acid,	1.30
Nitrogen,	3 87
Potassium oxide,	3.77
Insoluble matter,	24.97

Valuation per ton of two thousand pounds : —

23 4 pounds of soluble phosphoric acid,	$2 93
40.6 pounds of reverted phosphoric acid,	3 84

26.0 pounds of insoluble phosphoric acid,	$1 56
77.4 pounds of nitrogen,	18 58
75.4 pounds of potassium oxide,	3 77
	$30 68

Bowker's Hill and Drill.

(Collected of Messrs. Breck & Son, Boston.)

	Per cent.
Moisture,	16.60
Organic and volatile matter,	38.79
Ash constituents,	61.22
Total phosphoric acid,	13.89
Soluble phosphoric acid,	4.67
Reverted phosphoric acid,	3.40
Insoluble phosphoric acid,	5.82
Nitrogen,	2.65
Insoluble matter,	4.12

Valuation per ton of two thousand pounds: —

93.4 pounds of soluble phosphoric acid,	$11 68
68.0 pounds of reverted phosphoric acid,	6 12
116.4 pounds of insoluble phosphoric acid,	6 98
53.0 pounds of nitrogen,	12 72
	$37 50

Raw Bone Phosphate.

(E. H. Smith, Northborough, Mass.)

	Per cent.
Moisture,	11.36
Organic and volatile matter,	–
Ash constituents,	–
Total phosphoric acid,	12.85
Soluble phosphoric acid,	1.02
Reverted phosphoric acid,	7.29
Insoluble phosphoric acid,	4.54
Nitrogen,	2.53
Potassium oxide,	3.75
Insoluble matter,	4.27

Valuation per ton of two thousand pounds: —

20.4 pounds of soluble phosphoric acid,	$2 55
145.8 pounds of reverted phosphoric acid,	13 12
90.8 pounds of insoluble phosphoric acid,	5 45
50.6 pounds of nitrogen,	12 15
75.0 pounds of potassium oxide,	3 75
	$37 02

Turnip's Fertilizer.

(H. J. Baker & Bros. N. Y.; collected of Messrs. Newton & Fuller, Springfield, Mass.)

	Per cent.
Moisture,	12.75
Organic and volatile matter,	40.20
Ash constituents,	59.80
Total phosphoric acid,	5 84
Soluble phosphoric acid,	4.35
Reverted phosphoric acid,	.46
Insoluble phosphoric acid,	1.03
Nitrogen,	5.11
Potassium oxide,	10.82
Insoluble matter,	2.99

Valuation per ton of two thousand pounds: —

87.0 pounds of soluble phosphoric acid,	$10 88
9 2 pounds of reverted phosphoric acid,	83
20.6 pounds of insoluble phosphoric acid,	1 24
102.2 pounds of nitrogen,	24 53
216.4 pounds of potassium oxide,	10 82
	$48 30

L. B. Darling's Lawn Dressing.

(Collected of Parker & Gannett, Boston, Mass.)

	Per cent.
Moisture,	10.18
Organic and volatile matter,	42.45
Ash constituents,	57.55
Total phosphoric acid,	13.78
Soluble phosphoric acid,	.75
Reverted phosphoric acid,	4.94
Insoluble phosphoric acid,	8.89
Nitrogen,	3.27
Potassium oxide,	6 95
Insoluble matter,	1.38

Valuation per ton of two thousand pounds: —

15.0 pounds of soluble phosphoric acid,	$1 88
98.8 pounds of reverted phosphoric acid,	8 89
177.8 pounds of insoluble phosphoric acid,	10 67
65.4 pounds of nitrogen,	15 70
139.0 pounds of potassium oxide,	6 95
	$44 09

Food of Flowers.

(Bowker Fertilizer Co.; collected of Messrs. Wilder & Puffer, Springfield, Mass.)

	Per cent.
Moisture,	9.79
Organic and volatile matter,	48.56
Ash constituents,	51.44
Total phosphoric acid,	11.12
Soluble phosphoric acid,	9.00
Reverted phosphoric acid,	1.94
Insoluble phosphoric acid,	.18
Nitrogen,	4.77
Potassium oxide,	3.22
Insoluble matter,	.82

Valuation per ton of two thousand pounds: —

180.0 pounds of soluble phosphoric acid,	$22 50
38.8 pounds of reverted phosphoric acid,	3 49
3.6 pounds of insoluble phosphoric acid,	22
95.4 pounds of nitrogen,	22 90
64.4 pounds of potassium oxide,	3 22
	$52 33

E. F. Cook's Blood Guano.

(Bowker Fertilizer Co.; collected of Charles Parsons, Jr., Conway, Mass.)

	Per cent.
Moisture,	16.44
Organic and volatile matter,	50.03
Ash constituents,	49.97
Total phosphoric acid,	11.19
Soluble phosphoric acid,	5.12
Reverted phosphoric acid,	3.49
Insoluble phosphoric acid,	2.58
Nitrogen,	2.47
Potassium oxide,	1.58
Insoluble matter,	5.23

Valuation per ton of two thousand pounds: —

102.4 pounds of soluble phosphoric acid,	$12 80
69.8 pounds of reverted phosphoric acid,	6 28
51.6 pounds of insoluble phosphoric acid,	3 10
49.4 pounds of nitrogen,	11 86
31.6 pounds of potassium oxide,	1 58
	$35 62

E. F. Coe's Ammoniated Bone Superphosphate.

(Collected of Charles Parsons, Jr., Conway, Mass.)

	Per cent.
Moisture,	18.52
Organic and volatile matter,	48 87
Ash constituents,	51.19
Total phosphoric acid,	12.89
Soluble phosphoric acid,	8.62
Reverted phosphoric acid,	1.07
Insoluble phosphoric acid,	3.20
Nitrogen,	2.31
Potassium oxide,	.50
Insoluble matter,	4.24

Valuation per ton of two thousand pounds: —

172.4 pounds of soluble phosphoric acid,	$21 55
21.4 pounds of reverted phosphoric acid,	1 92
64.0 pounds of insoluble phosphoric acid,	3 84
46.2 pounds of nitrogen,	11 09
10.0 pounds of potassium oxide,	50
	$38 90

Bradley's XL.

(Collected of Messrs. Wilder & Puffer, Springfield, Mass.)

	Per cent.
Moisture,	16.23
Organic and volatile matter,	54 44
Ash constituents,	45.56
Total phosphoric acid,	10.26
Soluable phosphoric acid,	7.76
Reverted phosphoric acid,	.14
Insoluble phosphoric acid,	2.36
Nitrogen,	2.55
Potassium oxide,	3.15
Insoluble matter,	4.03

Valuation per ton of two thousand pounds: —

155.2 pounds of soluble phosphoric acid,	$19 40
2.8 pounds of reverted phosphoric acid,	25
47 2 pounds of insoluble phosphoric acid,	2 83
51.0 pounds of nitrogen,	12 24
63.0 pounds of potassium oxide,	3 15
	$37 87

Ammoniated Superphosphate.

(Preston & Son Fertilizer Co., New York; collected of Charles Parsons, Jr., Conway, Mass.)

	Per cent.
Moisture,	12.17
Organic and volatile matter,	44.33
Ash constituents,	55 67
Total phosphoric acid,	12.42
Soluble phosphoric acid,	7.40
Reverted phosphoric acid,	1.60
Insoluble phosphoric acid,	3.42
Nitrogen,	2.69
Potassium oxide,	.50
Insoluble matter,	8.78

Valuation per ton of two thousand pounds: —

148.0 pounds of soluble phosphoric acid,	$18 50
32.0 pounds of reverted phosphoric acid,	2 88
68.4 pounds of insoluble,	4 10
53.8 pounds of nitrogen,	12 91
10.0 pounds of potassium oxide,	50
	$38 89

Bowker's Phosphate.

(Collected of Messrs. Puffer & Wilder, Springfield, Mass.)

	Per cent.
Moisture,	13.58
Organic and volatile matter,	49.91
Ash constituents,	50.09
Total phosphoric acid,	8.00
Soluble phosphoric acid,	3.39
Reverted phosphoric acid,	2.43
Insoluble phosphoric acid,	2.18
Nitrogen,	3 00
Potassium oxide,	3.86
Insoluble matter,	4.06

Valuation per ton of two thousand pounds: —

67.8 pounds of soluble phosphoric acid,	$8 48
48.6 pounds of reverted phosphoric acid,	4 37
43.6 pounds of insoluble phosphoric acid,	2 62
60.0 pounds of nitrogen,	14 40
77.2 pounds of potassium oxide,	3 86
	$33 73

Bradley's Lawn Dressing.

(Messrs. Newcombe & Sheldon, Greenfield, Mass.)

	Per cent.
Moisture at 100° C.,	15.15
Organic and volatile matter,	34.20
Ash constituents,	65.80
Total phosphoric acid,	7.25
Soluble phosphoric acid,	4.86
Reverted phosphoric acid,	1.16
Insoluble phosphoric acid,	1.23
Nitrogen,	4.84
Potassium oxide,	7.00
Insoluble matter,	2.55

Valuation per ton of two thousand pounds: —

97.2 pounds of soluble phosphoric acid,	$12 15
23.2 pounds of reverted phosphoric acid,	2 09
24.6 pounds of insoluble phosphoric acid,	1 48
96.8 pounds of nitrogen,	23 23
140.0 pounds of potassium oxide,	7 00
	$45 95

Tobacco Fertilizer.

(Mapes Complete Fertilizer Co.; collected of Messrs. Newton & Fuller, Springfield, Mass.)

	Per cent.
Moisture,	12.80
Organic and volatile matter,	38.04
Ash constituents,	61.96
Total phosphoric acid,	8.14
Soluble phosphoric acid,	3.13
Reverted phosphoric acid,	3.90
Insoluble phosphoric acid,	1.11
Nitrogen,	3.65
Potassium oxide (sulphate),	7.79
Insoluble matter,	1.83

Valuation per ton of two thousand pounds: —

62.6 pounds of soluble phosphoric acid,	$7 83
78.0 pounds of reverted phosphoric acid,	7 02
22.2 pounds of insoluble phosphoric acid,	1 33
73.0 pounds of nitrogen,	17 52
155.8 pounds of potassium oxide,	10 90
	$44 60

Bowker's Hill and Drill Phosphate.

(Collected of C. T. Brown, Northampton, Mass.)

	Per cent.
Moisture,	16.83
Organic and volatile matter,	52.57
Ash constituents,	47.43
Total phosphoric acid,	12.55
Soluble phosphoric acid,	7.54
Reverted phosphoric acid,	2.65
Insoluble phosphoric acid,	2.36
Nitrogen,	2.88
Insoluble matter,	5 26

Valuation per ton of two thousand pounds: —

150.8 pounds of soluble phosphoric acid,	$18 85
53.0 pounds of reverted phosphoric acid,	4 77
47.2 pounds of insoluble phosphoric acid,	2 83
57.6 pounds of nitrogen,	13 82
	$40 27

Corn Fertilizer.

(Mapes & Co., New York; collected by Messrs. Newton & Fuller, Springfield, Mass.)

	Per cent.
Moisture,	12.15
Organic and volatile matter,	43.45
Ash constituents,	56.55
Total phosphoric acid,	12.05
Soluble phosphoric acid,	6.30
Reverted phosphoric acid,	4.63
Insoluble phosphoric acid,	1.12
Nitrogen,	5.29
Potassium oxide,	8.80
Insoluble matter,	6.95

Valuation per ton of two thousand pounds: —

126.0 pounds of soluble phosphoric acid,	$15 75
92.6 pounds of reverted phosphoric acid,	8 33
22.4 pounds of insoluble phosphoric acid,	1 34
105.8 pounds of nitrogen,	25 39
176 0 pounds of potassium oxide,	8 80
	$59 61

Tobacco Fertilizer.

(H. J. Baker & Bros., N. Y.; collected of Messrs. Newton & Fuller, Springfield, Mass.)

	Per cent.
Moisture,	12.46
Organic and volatile matter,	37.96
Ash constituents,	62.04
Total phosphoric acid,	2.86
Soluble phosphoric acid,	2.24
Reverted phosphoric acid,	0.36
Insoluble phosphoric acid,	0.26
Nitrogen,	4.55
Potassium oxide,	9.64
Insoluble matter,	0.46

Valuation per ton of two thousand pounds: —

44.8 pounds of soluble phosphoric acid,	$5 60
7.2 pounds of reverted phosphoric acid,	65
5.2 pounds of insoluble phosphoric acid,	31
91.0 pounds of nitrogen,	21 84
180.0 pounds of potassium oxide,	9 00
	$37 40

Potato Fertilizer.

(H. J. Baker & Bros., N. Y.; collected of Messrs. Newton and Fuller, Springfield, Mass.)

	Per cent.
Moisture,	11.58
Organic and volatile matter,	45.46
Ash constituents,	54.54
Total phosphoric acid,	5.16
Soluble phosphoric acid,	4.36
Reverted phosphoric acid,	.52
Insoluble phosphoric acid,	.28
Nitrogen,	3.97
Potassium oxide,	14.84
Insoluble matter,	2.53

Valuation per ton of two thousand pounds: —

87.2 pounds of soluble phosphoric acid,	$10 90
10.4 pounds of reverted phosphoric acid,	94
5.6 pounds of insoluble phosphoric acid,	34
79.4 pounds of nitrogen,	19 06
296.8 pounds of potassium oxide,	14 84
	$46 08

Bone and Potash Phosphate.

(Judson and Sparrow, Boston, Mass.)

	Per cent.
Moisture,	15 80
Volatile and organic matter,	60.00
Ash constituents,	40.00
Total phosphoric acid,	11.23
Soluble phosphoric acid,	9.72
Reverted phosphoric acid,	.42
Insoluble phosphoric acid,	1.09
Nitrogen,	3.73
Potassium oxide,	4.03
Insoluble matter,	.58

Valuation per ton of two thousand pounds: —

194.4	pounds of soluble phosphoric acid,	$24 30
8.4	pounds of reverted phosphoric acid,	76
21.8	pounds of insoluble phosphoric acid,	1 31
74.6	pounds of nitrogen,	17 90
80.6	pounds of potassium oxide,	4 30
		$48 30

Quinnipiac Co. Phosphate.

(Collected of Wm. H. Earle, Worcester, Mass.)

	Per cent.
Moisture,	20.05
Organic and volatile matter,	53.00
Ash constituents,	47.00
Total phosphoric acid,	10.55
Soluble phosphoric acid,	7.44
Reverted phosphoric acid,	.87
Insoluble phosphoric acid,	2.24
Potassium oxide,	3.80
Nitrogen,	3.31
Insoluble matter,	2.91

Valuation per ton of two thousand pounds: —

148.8	pounds of soluble phosphoric acid,	$18 60
17.4	pounds of reverted phosphoric acid,	1 57
44.8	pounds of insoluble phosphoric acid,	2 69
66.2	pounds of nitrogen,	15 89
76.0	pounds of potassium oxide,	3 80
		$42 55

Americus Brand, Ammoniated Bone Superphosphate.

(Collected of Wilson & Holden, Worcester, Mass.)

	Per cent.
Moisture,	9.95
Organic and volatile matter,	51 96
Ash constituents,	48.04
Total phosphoric acid,	10.88
Soluble phosphoric acid,	9.37
Reverted phosphoric acid,	.67
Insoluble phosphoric acid,	.84
Nitrogen,	2.38
Potassium oxide,	2.32
Insoluble matter,	6.28

Valuation per ton of two thousand pounds: —

187.4 pounds of soluble phosphoric acid,	$23 43
13.4 pounds of reverted phosphoric acid,	1 21
16.8 pounds of insoluble phosphoric acid,	1 01
47.6 pounds of nitrogen,	11 42
46.4 pounds of potassium oxide,	2 32
	$39 39

Bosworth Bros.' Superphosphate.

(Collected of Wilson & Holden, Worcester, Mass.)

	Per cent.
Moisture at 100° C.,	6.72
Organic and volatile matter,	43.53
Ash constituents,	56 47
Total phosphoric acid,	13.94
Soluble phosphoric acid,	4.43
Reverted phosphoric acid,	8.11
Insoluble phosphoric acid,	1.48
Nitrogen,	2.38
Insoluble matter,	1.60
Potassium oxide,	6.67

Valuation per ton of two thousand pounds: —

88.6 pounds of soluble phosphoric acid,	$11 08
162.2 pounds of reverted phosphoric acid,	14 60
29.6 pounds of insoluble phosphoric acid,	1 78
47 6 pounds of nitrogen,	11 43
133.4 pounds of potassium oxide,	6 67
	$45 56

Stockbridge Potatoes Manure.

(Collected of Rice Bros., Worcester, Mass.)

	Per cent.
Moisture,	19.23
Organic and volatile matter,	51.54
Ash constituents,	48.46
Total phosphoric acid,	9 34
Soluble phosphoric acid,	5.53
Reverted phosphoric acid,	1.05
Insoluble phosphoric acid,	2.94
Nitrogen,	2.59
Potassium oxide,	5.41
Insoluble matter,	3.95

Valuation per ton of two thousand pounds: —

110 6 pounds of soluble phosphoric acid,	$13 83
21.0 pounds of reverted phosphoric acid,	1 89
58.8 pounds of insoluble phosphoric acid,	3 53
51.8 pounds of nitrogen,	12 43
108.2 pounds of potassium oxide,	5 41
	$37 09

Nitrogenous Phosphate.

(O. H. Leach & Co., Boston, Mass.)

	Per cent.
Moisture,	18.08
Organic and volatile matter,	49.40
Ash constituents,	50.60
Total phosphoric acid,	9.26
Soluble phosphoric acid,	5.95
Reverted phosphoric acid,	2.25
Insoluble phosphoric acid,	1.06
Nitrogen,	2.44
Potassium oxide,	0.91
Insoluble matter,	.63

Valuation per ton of two thousand pounds: —

119.0 pounds of soluble phosphoric acid,	$14 88
45.0 pounds of reverted phosphoric acid,	4 05
21.2 pounds of insoluble phosphoric acid,	1 27
48.8 pounds of nitrogen,	11 71
18.2 pounds of pota-sium oxide,	91
	$32 82

Pure Ground Bone Phosphate.

(Of A. L. Ames, Peabody, Mass.)

	Per cent.
Moisture,	7.04
Organic and volatile matter,	49.23
Ash constituents,	50.78
Total phosphoric acid,	16.18
Soluble phosphoric acid,	3.96
Reverted phosphoric acid,	3.56
Insoluble phosphoric acid,	8.65
Nitrogen,	3.87
Insoluble matter,	1.37

Valuation per ton of two thousand pounds:—

78.2 pounds of soluble phosphoric acid,	$9 69
71.2 pounds of reverted phosphoric acid,	6 41
173.0 pounds of insoluble phosphoric acid,	10 38
77.4 pounds of nitrogen,	18 58
	$45 06

Bradley's Grass Seeding Fertilizer.

(Collected by Messrs. Sheldon & Newcomb, Greenfield, Mass.)

	Per cent.
Moisture at 100° C.,	9.31
Organic and volatile matter,	43.37
Ash constituents,	56.73
Total phosphoric acid,	14.32
Soluble phosphoric acid,	7.09
Reverted phosphoric acid,	2.43
Insoluble phosphoric acid,	4.80
Nitrogen,	3.00
Potassium oxide,	4.00
Insoluble matter,	3.97

Valuation per ton of two thousand pounds:—

141.8 pounds of soluble phosphoric acid,	$17 73
48.6 pounds of reverted phosphoric acid,	4 37
96.0 pounds of insoluble phosphoric acid,	5 76
60.0 pounds of nitrogen,	14 40
80.0 pounds of potassium oxide,	4 00
	$46 26

Clark's Cove Guano.

(Collected of Messrs. Parker & Gannett, Boston, Mass.)

	Per cent.
Moisture,	16.82
Organic and volatile matter,	42.85
Ash constituents,	57.15
Total phosphoric acid,	10.40
Soluble phosphoric acid,	8.19
Reverted phosphoric acid,	1.58
Insoluble phosphoric acid,	0.63
Nitrogen,	2.18
Potassium oxide,	2.26
Insoluble matter,	13.14

Valuation per ton of two thousand pounds: —

163.8 pounds of soluble phosphoric acid,	$20 48
31.6 pounds of reverted phosphoric acid,	2 84
12.6 pounds of insoluble phosphoric acid,	76
43.6 pounds of nitrogen,	10 46
45.2 pounds of potassium oxide,	2 26
	$36 80

Standard Superphosphate.

(Collected of William H. Earle, Worcester, Mass.)

	Per cent.
Moisture,	20.89
Organic and volatile matter,	47.06
Ash constituents,	52.94
Total phosphoric acid,	11.67
Soluble phosphoric acid,	5.92
Reverted phosphoric acid,	2.97
Insoluble phosphoric acid,	2.78
Nitrogen,	2.34
Potassium oxide,	1.30
Magnesium oxide,	1.60
Insoluble matter,	4.32

Valuation per ton of two thousand pounds: —

118.4 pounds of soluble phosphoric acid,	$14 79
59 4 pounds of reverted phosphoric acid,	5 35
55.6 pounds of insoluble phosphoric acid,	3 34
46.8 pounds of nitrogen,	11 23
26.0 pounds of potassium oxide,	1 30
	$36 01

Bowker's Animal Fertilizer.

(Collected of Messrs. Breck & Son, Boston, Mass.)

	Per cent.
Moisture,	4.95
Organic and volatile matter,	46.55
Ash constituents,	48.46
Total phosphoric acid,	12.02
Soluble phosphoric acid,	6.08
Reverted phosphoric acid,	1.83
Insoluble phosphoric acid,	4.11
Nitrogen,	3.46
Potassium oxide,	4.10
Insoluble matter,	5 65

Valuation per ton of two thousand pounds: —

121.6 pounds of soluble phosphoric acid,	$15 20
36.6 pounds of reverted phosphoric acid,	3 29
82.2 pounds of insoluble phosphoric acid,	4 93
69.2 pounds of nitrogen,	16 61
82.0 pounds of potassium oxide,	4 10
	$44 13

Bradley's XL.

(Collected of Messrs. Rice Bros., Worcester, Mass.)

	Per cent.
Moisture,	14.90
Organic and volatile matter,	54.60
Ash constituents,	45.40
Total phosphoric acid,	12.51
Soluble phosphoric acid,	8.06
Reverted phosphoric acid,	2.24
Insoluble phosphoric acid,	2.21
Nitrogen,	3 00
Potassium oxide,	2.67
Insoluble matter,	4 33

Valuation per ton of two thousand pounds: —

161.2 pounds of soluble phosphoric acid,	$20 15
44.8 pounds of reverted phosphoric acid,	4 03
44.2 pounds of insoluble phosphoric acid,	2 65
60.0 pounds of nitrogen,	14 40
53.4 pounds of potassium oxide,	2 67
	$43 90

Farmers' Friend.

(Read & Co., New York, N. Y.; collected of Messrs. Newton & Fuller, Springfield, Mass.)

	Per cent.
Moisture at 100° C.,	15.46
Total phosphoric acid,	12.24
Soluble phosphoric acid,	7.81
Reverted phosphoric acid,	2.44
Insoluble phosphoric acid,	1.99
Nitrogen,	2 13
Potassium oxide,	3.50
Insoluble matter,	6.52

Valuation per ton of two thousand pounds: —

156.2 pounds of soluble phosphoric acid,	$19 53
48.8 pounds of reverted phosphoric acid,	4 39
39.8 pounds of insoluble phosphoric acid,	2 39
42.6 pounds of nitrogen,	10 23
70.0 pounds of potassium oxide,	3 50
	$40 04

Bradley's Sea Fowl.

(Collected of Messrs. Puffer & Wilder, Springfield, Mass.)

	Per cent.
Moisture at 100° C.,	13.70
Total phosphoric acid,	11.45
Soluble phosphoric acid,	7.87
Reverted phosphoric acid,	1.01
Insoluble phosphoric acid,	2.57
Nitrogen,	2.73
Potassium oxide,	2.58
Insoluble matter,	4.90

Valuation per ton of two thousand pounds: —

157.4 pounds of soluble phosphoric acid,	$19 67
20.2 pounds of reverted phosphoric acid,	1 82
51.4 pounds of insoluble phosphoric acid,	3 08
54.6 pounds of nitrogen,	13 10
51.6 pounds of potassium oxide,	2 58
	$40 25

L. B. Darling's Animal Fertilizer.

(Collected of Messrs. Parker & Gannett, Boston, Mass.)

	Per cent.
Moisture,	7.95
Organic and volatile matter,	48.49
Ash constituents,	50.51
Total phosphoric acid,	15.20
Soluble phosphoric acid,	.49
Reverted phosphoric acid,	5.22
Insoluble phosphoric acid,	9.49
Nitrogen,	5.79
Potassium oxide,	4.74
Insoluble matter,	2.66

Valuation per ton of two thousand pounds: —

9.8 pounds of soluble phosphoric acid,	$1 23
104.4 pounds of reverted phosphoric acid,	9 40
189.8 pounds of insoluble phosphoric acid,	11 39
115.8 pounds of nitrogen,	27 79
94.8 pounds of potassium oxide,	4 74
	$54 55

E. Frank Coe's Ammoniated Bone Superphosphate.

(Messrs. Sheldon & Newcomb, Greenfield, Mass.)

	Per cent.
Moisture at 100° C.,	11.49
Organic and volatile matter,	45.96
Ash constituents,	54.04
Total phosphoric acid,	13.07
Soluble phosphoric acid,	7.62
Reverted phosphoric acid,	1.26
Insoluble phosphoric acid,	4.22
Nitrogen,	2.02

Valuation per ton of two thousand pounds: —

152.4 pounds of soluble phosphoric acid,	$19 05
25.2 pounds of reverted phosphoric acid,	2 27
84.4 pounds of insoluble phosphoric acid,	5 07
40.4 pounds of nitrogen,	9 70
	$36 09

Bay State Bone Superphosphate.

(Collected of Messrs. J. Clark & Son, Worcester, Mass.)

	Per cent.
Moisture,	25.39
Organic and volatile matter,	63.78
Ash constituents,	36.22
Total phosphoric acid,	10.89
Soluble phosphoric acid,	7.22
Reverted phosphoric acid,	2.75
Insoluble phosphoric acid,	.92
Nitrogen,	2.14
Insoluble matter,	.74

Valuation per ton of two thousand pounds: —

144.4 pounds of soluble phosphoric acid,	$18 05
55.0 pounds of reverted phosphoric acid,	4 95
18.4 pounds of insoluble phosphoric acid,	1 10
42,8 pounds of nitrogen,	10 27
	$34 37

Bradley's Sea Fowl.

(Messrs. Shelden & Newcomb, Greenfield, Mass.)

	Per cent.
Moisture at 100° C.,	18.25
Organic and volatile matter,	51.03
Ash constituents,	48.97
Total phosphoric acid,	11.46
Soluble phosphoric acid,	8.03
Reverted phosphoric acid,	1.75
Insoluble phosphoric acid,	1.68
Nitrogen,	3.45
Potassium oxide,	3.69
Insoluble matter,	4.80

Valuation per ton of two thousand pounds: —

160.6 pounds of soluble phosphoric acid,	$20 08
35.0 pounds of reverted phosphoric acid,	3 15
33.6 pounds of insoluble phosphoric acid,	2 02
69.0 pounds of nitrogen,	16 56
73.8 pounds of potassium oxide,	3 69
	$45 50

Soluble Pacific Guano.

(Collected of T. Clark & Son, Worcester, Mass.)

	Per cent.
Moisture,	14.95
Organic and volatile matter,	44.26
Ash constituents,	55.74
Total phosphoric acid,	10.30
Soluble phosphoric acid,	7.36
Reverted phosphoric acid,	.32
Insoluble phosphoric acid,	2.62
Nitrogen,	2.65
Potassium oxide,	3.81
Insoluble matter,	5.78

Valuation per ton of two thousand pounds: —

147.2 pounds of soluble phosphoric acid,	$19 00
6.4 pounds of reverted phosphoric acid,	58
52.4 pounds of insoluble phosphoric acid,	3 14
53.0 pounds of nitrogen,	12 72
76.2 pounds of potassium oxide,	3 81
	$39 25

Mitchell's Standard Superphosphate.

(Collected of Messrs. Rice Brothers, Worcester, Mass.)

	Per cent.
Moisture,	33.42
Organic and volatile matter,	66.96
Ash constituents,	33.04
Total phosphoric acid,	7.41
Soluble phosphoric acid,	5.14
Reverted phosphoric acid,	1.49
Insoluble phosphoric acid,	.78
Nitrogen,	1.61
Potassium oxide,	1.87
Insoluble matter,	1.83

Valuation per ton of two thousand pounds: —

102.8 pounds of soluble phosphoric acid,	$12 85
29.8 pounds of reverted phosphoric acid,	2 68
15.6 pounds of insoluble phosphoric acid,	94
32.2 pounds of nitrogen,	7 72
37.4 pounds of potassium oxide,	1 87
	$26 06

The sample which furnished the analysis was exceptionably wet, and seems to have suffered from access of water; the good quality of the same brand in the hands of the same agents in the preceding year supports the explanation given by the manufacturer.

Bradley's XL.

(Collected of Wm. H. Earle, Worcester, Mass.)

	Per cent.
Moisture,	16.70
Organic and volatile matter,	48.50
Ash constituents,	51.50
Total phosphoric acid,	12.17
Soluble phosphoric acid,	9.02
Reverted phosphoric acid,	1.42
Insoluble phosphoric acid,	1.73
Nitrogen,	2.78
Potassium oxide,	3.14
Insoluble matter,	3.50

Valuation per ton of two thousand pounds: —

180.4 pounds of soluble phosphoric acid,	$22 55
28.4 pounds of reverted phosphoric acid,	2 56
34.6 pounds of insoluble phosphoric acid,	2 08
55.6 pounds of nitrogen,	13 35
62.8 pounds of potassium oxide,	3 14
	$43 68

IXL Ammoniated Bone Superphosphate.

(Geo. N. Miles & Co.; collected of D. N. Dwight, Northampton, Mass.)

	Per cent.
Moisture,	20.65
Organic and volatile matter,	56.51
Ash constituents,	43.49
Total phosphoric acid,	10.41
Soluble phosphoric acid,	7.38
Reverted phosphoric acid,	1.19
Insoluble phosphoric acid,	1.84
Nitrogen,	2.24
Potassium oxide,	1.88
Insoluble matter,	4.07

Valuation per ton of two thousand pounds: —

147.6 pounds of soluble phosphoric acid,	$18 45
23.8 pounds of reverted phosphoric acid,	2 14
36.8 pounds of insoluble phosphoric acid,	2 21
44.8 pounds of nitrogen,	10 75
37.6 pounds of potassium oxide,	1 88
	$35 43

Ammoniated Bone Superphosphate.

(Stearns & Co.; sent on by George E. Craig, Boston, Mass.)

	Per cent.
Moisture,	15.58
Organic and volatile matter,	52.80
Ash constituents,	47.20
Total phosphoric acid,	9.82
Soluble phosphoric acid,	9.33
Insoluble phosphoric acid,	.49
Nitrogen,	2.59
Potassium oxide,	1 88
Insoluble matter,	6.48

Valuation per ton of two thousand pounds: —

186.6 pounds of soluble phosphoric acid,	$23 33
9.8 pounds of insoluble phosphoric acid,	59
51.8 pounds of nitrogen,	12 43
37.6 pounds of potassium oxide,	1 88
	$38 23

Bowker's Lawn Dressing.

(Collected of Puffer & Wilder, Springfield, Mass.)

	Per cent.
Moisture,	11.68
Organic and volatile matter,	50.43
Ash constituents,	49.57
Total phosphoric acid,	7.62
Soluble phosphoric acid,	5.05
Reverted phosphoric acid,	1.49
Insoluble phosphoric acid,	1.08
Nitrogen,	3.73
Potassium oxide,	5.78
Insoluble matter,	.60

Valuation per ton of two thousand pounds: —

101.0 pounds of soluble phosphoric acid,	$12 62
29.8 pounds of reverted phosphoric acid,	2 68
21.6 pounds of insoluble phosphoric acid,	1 30
74.6 pounds of nitrogen,	17 90
115.6 pounds of potassium oxide,	5 78
	$40 28

Potato Fertilizer.

(Mapes Complete Fertilizer Co.; collected of Messrs. Newton & Fuller, Springfield, Mass.)

	Per cent.
Moisture,	11.63
Organic and volatile matter,	57.74
Ash constituents,	42.26
Total phosphoric acid,	8.38
Soluble phosphoric acid,	2.59
Reverted phosphoric acid,	2.80
Insoluble phosphoric acid,	2.99
Nitrogen,	3.12
Potassium oxide,	5.45
Insoluble matter,	4.74

Valuation per ton of two thousand pounds: —

51.8 pounds of soluble phosphoric acid,	$6 48
56.0 pounds of reverted phosphoric acid,	5 04
59.8 pounds of insoluble phosphoric acid,	3 59
62.4 pounds of nitrogen,	14 97
109.0 pounds of potassium oxide,	5 45
	$35 53

The Standard Superphosphate.

(Collected of Messrs. Whittemore Bros., Boston, Mass.)

	Per cent.
Moisture,	22.48
Organic and volatile matter,	41.10
Ash constituents,	58.90
Total phosphoric acid,	10.72
Soluble phosphoric acid,	6.27
Reverted phosphoric acid,	2.18
Insoluble phosphoric acid,	2.27
Nitrogen,	2.64
Potassium oxide,	2.09
Insoluble matter,	7.41
Magnesium oxide,	1.58

Valuation per ton of two thousand pounds: —

125.4 pounds of soluble phosphoric acid,	$15 68
43.6 pounds of reverted phosphoric acid,	3 92
45.4 pounds of insoluble phosphoric acid,	2 72
52.8 pounds of nitrogen,	12 67
41.8 pounds of potassium oxide,	2 09
	$37 08

Complete Manure.

(Messrs. Whittemore Bros., Wayland, Mass. Sent on for examination.)

	Per cent.
Moisture,	6.30
Organic and volatile matter,	54.88
Ash constituents,	45.12
Total phosphoric acid,	15.36
Reverted phosphoric acid,	4.92
Soluble phosphoric acid,	7.20
Insoluble phosphoric acid,	3.24
Nitrogen,	2.93
Insoluble matter,	1.50

Valuation per ton of two thousand pounds: —

144.0 pounds of soluble phosphoric acid,	$18 00
98.4 pounds of reverted phosphoric acid,	8 86
64.8 pounds of insoluble phosphoric acid,	3 89
58.6 pounds of nitrogen,	14 06
	$44 81

Complete Grass Manure.

(Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture,	9.28
Organic and volatile matter,	35.10
Ash constituents,	64.90
Phosphoric acid,	6.54
Potassium oxide,	4.77
Insoluble matter,	.57
Nitrogen,	5.40

Valuation per ton of two thousand pounds: —

130.8 pounds of phosphoric acid,	$7 84
108.0 pounds of nitrogen,	25 92
95.4 pounds of potassium oxide,	4 77
	$38 53

APPENDIX.

COMPOSITION OF SOME COMPOUNDS IN FERTILIZERS.

One hundred parts of:—

Nitric acid contain 26 parts of nitrogen.

Ammonia contain 82.35 parts of nitrogen.

Pure nitrate of potassa (saltpetre) contain 53.4 parts of nitric acid and 46.6 parts of potassium oxide.

Pure nitrate of soda (Chili saltpetre) contain 63.25 parts of nitric acid.

Chloride of potassium contain 52.4 parts of potassium, 63.1 parts of potassium oxide, and 47.6 parts of chlorine.

Pure sulphate of potassa contain 54.9 parts of potassium oxide and 46 parts of sulphuric acid.

Bone phosphate (tricalcic phosphate) contain 46 parts of phosphoric acid and 54 parts of calcium oxide (lime).

Calcined gypsum contain 41 parts of calcium oxide (lime) and 59 parts of sulphuric acid.

Uncalcined pure gypsum contain 32.5 parts of calcium oxide (lime), 46.5 parts of sulphuric acid, and 21 parts of water.

Carbonate of lime contain 56 parts of calcium oxide (lime) and 44 parts of carbonic acid.

Sulphate of magnesia (free of water) contain 33.3 per cent. of magnesium oxide (magnesia) and 66.6 per cent of sulphuric acid.

C. A. GOESSMANN.

The report was accepted.

Mr. Ware read his paper upon "The Silo and Ensilage," which was discussed and adopted.

ESSAY ON THE SILO AND ENSILAGE.

BY BENJ. P. WARE.

The system of preserving grain, fruits, and forage in subterranean vaults, in its green state, is spoken of by the earliest writers as being commonly practised by the ancient Romans, and has been practised by the Mexicans for centuries. In France, Germany and other countries of Europe, green crops of all kinds have been buried in pits for preservation for more than fifty years with more or less success. But to M. Auguste Goffart, a distinguished member of the Central Agricultural Society of France, belongs the honor

of having perfected the system of preserving in silos, for an indefinite time, all green forage crops substantially in their natural condition for food for all kinds of farm stock.

He began his experiments in 1850, but was only able to preserve his green fodder for three or four weeks, until 1873, when he had better success. Not until 1876 did he discover the necessity of continuous pressure, by which only can complete success be secured.

Goffart published his whole experience to the world, and in 1879 J. M. Brown, Esq., of New York, translated and published his work, giving to the farmers of the United States reliable information upon this method that is rapidly producing an entire change in the system of agriculture in this country.

To Mr. J. M. Brown, as well as to M. Auguste Goffart, do many of our most prominent farmers who have adopted it, acknowledge a debt of gratitude.

In 1873 Francis M. Appleton of Lynnfield, Essex County, while making a tour in Europe, was shown in Hungary the method of burying green corn fodder in pits, to make what they called sour hay. Although much waste resulted from this method, and the contents of the pit opened in what would now be considered bad condition, it proved a wholesome food for cattle, and an economical system of preserving the fodder. Mr. Appleton obtained from his Hungarian friend a description of it, for publication in this country, which appeared in the *American Agriculturist* for October, 1873. Mr. Appleton copied it into his essay on Foreign Agricultural Experience, which was published in the Transactions of the Essex Agricultural Society for 1873.

This is believed to be the first information published in this country on the subject of ensilage. In 1875 Mr. C. W. Mills of New Jersey buried a large quantity of white dent corn which had grown to an enormous size, but failed to mature its ears, in large pits under five feet of earth, for the purpose of getting it out of sight. In the spring, instead of finding a manure heap, he discovered an immense quantity of valuable food for his cows, that they liked better than any other fodder. He thus early by accident discov-

ered, without any previous knowledge of it, the process of ensilage, and has since made a complete success of it.

Mr. Francis Morris of Maryland in 1876 first filled brick silos on a large scale with tolerable success. John M. Bailey, Esq., of Billerica, Mass., was the first man in New England who dared to build and fill a silo after the instructions of A. Goffart, and take the chances of loss in the investment, the ridicule and obloquy of his neighbors and the community at large, in case of failure; or of pecuniary advantage, with the honor and respect of all progressive farmers, if successful. I believe he is eminently satisfied with the results after three years' experience.

There can be no doubt but that good farming must be based upon cattle, sheep and swine. But each individual farmer must decide for himself whether it is best for him to keep farm stock, taking into consideration his location and kind of farming most profitable for him.

But for him who does keep live farm stock, the question, How shall it be fed at the least cost, and to be kept in the best condition? is a very serious one, especially in New England, with its hard and comparatively barren soil and severe winters. While grass is crowned king, corn must be acknowledged queen, of the forage crops. Clover, rye, oats, barley and the several millets may be supplemented to advantage, but the principal dependence must be upon the two first named.

The great question of to-day among farmers is, How shall the greatest amount of nutritious ingredients of the forage plants be preserved at the least cost?

Fermentation that tends to decomposition or putrefaction requires the presence of heat, air, and moisture; the elimination of either one of these conditions will prevent fermentation. By dessication, hay is preserved by removing the moisture, while air and heat remain. By the absence of heat, as in cold storage, air and moisture remain, decomposition is checked. And, by the exclusion of air, heat and moisture remaining, the same result is obtained. Chemistry teaches that no valuable nutritive qualities of grass or other green forage plants are lost by drying. It also teaches that by the cutting of any green or living plant and slight expos-

ure to the air, a molecular action sets in, which converts the starch and sugar of the plant into lactic acid. The oxygen of the air does not enter into this action, and the chemical constituents of the substance remain as before, the same quantities of the same elements, but in different combination. But this change *does* affect the feeding value of the substance to a considerable degree, so that in putting ensilage into the silo under the best conditions that the farmer can provide, a loss of feeding value of from twenty to twenty-five per cent. must inevitably occur. Under less favorable conditions, as when the air is less fully expelled from the ensilage, alcoholic fermentation takes place, from which, as further oxidation goes on, acetic acid is produced. Then at least fifty per cent. of the feeding value is lost.

Chemists, however, admit that possibly the formation of lactic acid to a certain amount in the ensilage, may, in the absence of air, act as an antiseptic, and thus check further decomposition; and also, that this acid, being a normal constituent of the contents of some of the digestive organs of animals, may render the ensilage more fully digestible, and thereby increase its value to some undetermined extent.

It does thus appear that the chemistry of ensilage is certainly very much against this method of preserving green forage. Chemists, and most of those persons who have had no experience in feeding ensilage, are opposed to this system as being costly and wasteful. But hundreds of careful, observing farmers who have had from one to five years' experience in its use, to a man, pronounce it the most economical and profitable method of preserving and feeding green crops to all farm live-stock, and especially for dairy products and growing animals.

This wide difference of opinion may be, perhaps, reasonably accounted for by the fact that the chemist deals, in his laboratory, entirely with dead matter, while the farmer deals with life in the food and life of animals. The chemistry of life and the chemistry of death may differ as much as the difference in opinion that exists between the chemist and the farmer upon this subject. For instance, to the farmer, fresh June grass appears to be a complete food for farm live-stock, producing the greatest growth in young stock,

and the sweetest, yellow butter in the dairy. The chemist finds no difference between the grass and the hay made from it, perhaps because he makes hay of it before his analysis, although it is found to lack a proper proportion of protein for a complete food; that butter made from it is of indifferent flavor and lacks color, and that it produces less growth and less quantity of milk. The same difference in results appears between the feeding of ensilage, and the same material fed after being preserved by drying.

Now, as these stubborn facts, that have been developed by the feeding of ensilage during the past few years, will not adapt themselves to the theory established by chemists in the laboratory, would it not be well for the chemist to pause, and endeavor to find reasons that will bear the test of chemical investigation, for these well established facts so much at variance with the present development of the laboratory, and promulgate a theory more in accordance therewith?

No one can appreciate, more than the writer, the benefits that agriculture has derived from chemistry during the last fifty years, or is more anxious that this discrepancy should be cleared up and explained. For farmers have learned to look to the science of chemistry to unravel many mysteries, and remove many obstacles that now block progress in the art of farming.

Below are given the analyses of two lots of corn at the time they were cut green for ensilage, and again, two months and a half after being put in the silo. The analyses were made at the Massachusetts Agricultural Experiment Station at Amherst.

Lot No. I. was cut when in full tassel and ears just forming, showing silk but no grain.

Lot No. II. was cut before any tassels appeared. Both lots were cut when in vigorous growth.

I.

	From three feet below surface.			
	Green corn for ensilage.	Corn ensilage.		
Moisture,	84.880	84.125	— difference,	.755
Dry matter,	15.120	15.878	— difference,	.755
Ash constituents,	1.041	1.156	— gain,	11.066
Crude cellulose,	4.684	6.003	— gain,	25.216
Fat (ether abstract),	0.109	0.363	— gain,	232.844
Carbo-hydrates, non-nitrogenous extract matter,	8.054	7.045	— loss,	12.521
Protein, nitrogenous matter,	1.233	1.307	— gain,	5.912

II.

	From two feet below surface.			
	Green corn for ensilage.	Ensilage.		
Moisture,	87.974	87.882	— difference,	.091
Dry matter,	12.026	12.117	— difference,	.091
Ash constituents,	1.155	1.054	— loss,	8.744
Crude cellulose,	4.037	4.035	— loss,	0.0447
Fat (ether abstract),	0.233	0.306	— gain,	31.712
Carbo-hydrate, non-nitrogenous extract matter,	5.299	5.469	— gain,	3.2
Protein, nitrogenous matter,	1.302	1.254	— loss,	3.664

A bag of corn from Lot No. I., cut for ensilage, was placed in the silo with the ensilage, nine feet below the surface. The bag was moistened sufficiently to prevent its absorbing moisture from the ensilage. It then weighed thirty-two pounds, and on being taken out, four months afterwards, showed precisely the same weight.

In response to a circular letter of inquiry for full statements of results of experience in building silos, and feeding ensilage, which was issued June 10, 1882, by the commissioner of the Department of Agriculture at Washington, answers were received from sixty-nine prominent farmers located in different parts of this country and Canada. In every instance they were favorable to ensilage as a profitable method of preserving green fodder.

From a summary of these replies, and from my own experience, the following facts and recommendations are given: —

The silo should be located near where the ensilage is to be fed, but separated from the live stock, especially where cows are milked, so that no gaseous emanations from the silo can affect the flavor of the milk by their odors, which has in a few instances occurred. A parallelogram is the best form for a silo. It should be partly underground, with solid concrete or stone walls, smoothly cemented, and made impervious to water. The part that is above ground may be of wood, with strong frame to support the lateral pressure, and ceiled with planed, matched boards, one thickness being sufficient. The deeper the silo the better, up to thirty feet. The covering should be of plank, or of battened boards, from two to four feet wide, laid directly upon the ensilage, allowing space for settling, without pressure against the sides of the silo. This covering must be weighted with any heavy material most convenient. Nothing is better than stones that a man can handle conveniently. A pressure of two hundred pounds to the square foot is requisite for good results. The cost of building walls of masonry is from three dollars and a half to five dollars per ton of capacity, and fifty cents, or less, for wooden structures.

While corn takes the lead as a crop for ensilage, any other crop used for soiling cattle makes good ensilage. The varieties of corn making the largest growth, such as the Southern White or Blunt's Prolific, give the best results. With good fertilization and cultivation, from twelve to fifty tons may be grown on an acre, according to circumstances. From twenty to twenty-five tons may be considered an average crop. Cultivation with the Thomas Smoothing Harrow, until the corn is eight inches high, and with a horse-cultivator once later is sufficient; no hand hoeing is required.

The average total cost of raising and filling the crop into the silo, as taken from the accounts kept by fourteen growers, is two dollars and sixty-three cents per ton. The cost varied from ninety-two cents in Nebraska to four dollars in Lawrence and North Andover, Mass.

The best stage of growth to cut ensilage is when the grain is in milk. Three pecks or a bushel of seed to the acre, sown in drills, from three and one-half to four feet apart, has given the best general satisfaction.

The usual practice has been to cut the fodder for ensilage three-eighths or one-half inch long, and to tramp it thoroughly; but, inasmuch as the breaking or cutting the cellular structure of the plant produces molecular fermentation, it would seem that the less cutting and mashing of the cells of the plant there is by treading (consistent with proper levelling), the better; and it is found that with sufficient weighting (two hundred pounds to the square foot), cutting an inch or an inch and a half long gives better results, by producing less fermentation, and hence better quality of ensilage.

The experience of the past year has enabled farmers to control fermentation in the silo better than ever before, hence the ensilage is generally less acid.

Ensilage has been kept two or more years in the silo in good condition, and it is not in its best condition until it has had at least two months' curing in the silo.

An ordinary sized cow will eat on an average sixty pounds of ensilage per day, which should be fed in two rations, morning and evening. Corn ensilage is not considered a complete food, as it does not contain protein, carbohydrates, and fat in proper proportions — protein and fat being deficient for an economical feeding standard. This lack should be made up with articles rich in these ingredients, such as cotton seed or Indian meal. It should be considered as a substitute for hay and roots, but not for grain. All kinds of farm live-stock eat it with avidity when fed as a substitute for hay and roots. They thrive better, and yield an increase in milk and flesh, from nine to twenty per cent. more than when fed on good hay; the milk, butter and flesh produced from it being of superior quality, resembling that from June grass, and the cost of feeding stock with it is less than one half that of hay, when valued at twenty dollars per ton. It has been proved that cattle fed upon it year after year continue in thrift and health.

Many have claimed that two tons of good ensilage were worth as much as one ton of English hay; but by a carefully conducted experiment, it proved that with hay at twenty dollars per ton, a ton of corn ensilage was worth for

producing milk and flesh $7.26, making $2\frac{3}{4}$ tons equal in value to one ton of hay.

It requires a good five or six horse power steam-engine to run a 20-inch cutter effectively. With such power a large horseload of corn was cut $1\frac{1}{2}$ inches long in five minutes repeatedly last season, but nine minutes was the usual time occupied. A two-horse tread-mill will do good work with such a cutter. John G. Walcott of Peabody filled silos in Essex County last season with a portable six-horse engine and 20-inch cutter for seventy-five cents per ton, the corn being delivered to the cutter from the field. This is a practical way of avoiding the objection of each farmer going to the expense of running the necessary machinery. At a convention of farmers and others interested in ensilage from different parts of the country held at New York in January of 1882, after full discussion, the following resolution was adopted : —

Resolved, That it has become a well-established fact, after six years' successful use in this country, and by the concurrent testimony of many intelligent farmers, that the ensilage system is of great advantage to the farming interest, as well as to all mankind.

One year later, after another year's experience, a similar convention was held at the same place for the same purpose. The following resolution was adopted : —

Resolved, That the Ensilage Congress, assembled in New York Jan. 25, 1883, desire to express to M. Auguste Goffart of France their appreciation of the great value of the system of ensilage discovered and introduced by him. They recommend to the farmers of the United States its universal adoption as the cheapest and best method of preserving fodder crops.

In order to show the cost of growing ensilage corn and putting it into the silo, and what may be considered a good method of conducting the system, and also what may be expected as the results from good land under ordinary circumstances, I will give in detail my account with a three-acre lot that had been in pasture for ten years, the planting of which was finished June 28th, 1882.

DR.

To breaking up with pair of horses and sidehill plough 3 acres at $5, ...	$15 00	
harrowing thoroughly with spring-tooth harrow, 2 days, men and pair horses at $4, ...	8 00	
harrowing with fine harrow and brush, $\frac{1}{2}$ day, man and pair horses, ...	2 00	
planting with Ross's corn planter by 2 men and 1 horse, $\frac{3}{4}$ day, at $1.25 each, ...	2 81	
30 cwt. of Ames' fertilizer, at $35 per ton, . . .	52 50	
spreading the same broadcast, 1 man and horse $\frac{1}{2}$ day, ...	1 25	
$\frac{3}{4}$ bush. Southern white seed corn per acre $2\frac{1}{4}$ bush., at $1.50, ...	3 37	
July 12, harrowed over the whole with Thomas's smoothing harrow in 2 hours, corn 4 in. high,	1 00	
July 22, harrowed 2d time with same, corn 8 in. high,	1 00	
July 29, cultivated thoroughly twice between the rows, 2 days, man and horse, ...	5 00	
Total, ...		$91 93

It will be noticed that the whole of the fertilizer is charged to crop.

Oct. 10. Finished filling the silo with the following labor:—

4 men in the field cutting and loading the corn.
2 horses and tip-carts with 1 boy to drive to silo.
3 men feeding the cutter.
2 boys to shove the cut corn into the silo (this is an unusual charge, it being 12 feet off).
1 man to run the engine and level in the silo.

Equal to $11\frac{1}{2}$ men $3\frac{1}{2}$ days filling at $1.25 each, . .	$50 30	
$3\frac{1}{2}$ days' use of machinery at $6, ...	21 00	
$\frac{1}{2}$ ton coal, ...	3 00	
		74 30
Total cost of the ensilage in the silo, ...		$166 23

CR.

By 2 tons hay per acre, by estimate, before ploughing, 6 tons at $15, standing, ...		$90 00
30 tons corn per acre, estimated, on 2 acres, . .	60 tons,	
12 tons corn on one acre, estimated, which suffered badly by drought, ...	12 "	
	72 tons,	
Value of ensilage compared with hay at $20 per ton, $7 26 × 72 =		522 72
Total value of products of the lot, ...		$612 72
Deduct total cost ensilage in the silo, 72 tons at $$2.32\frac{1}{4}$, . . .		166 23
Net value of product of the lot, ...		$446 49

Mr. Ware's paper was discussed and adopted.

Voted, That the Secretary is instructed not to pay the expenses of more than one member of the Board to each institute.

Voted, That all unfinished business be referred to the Committee on Printing, with full powers.

All papers and reports that had been laid over were read by their titles, and accepted.

Adjourned *sine die*.

JOHN E. RUSSELL,
Secretary of the State Board of Agriculture.

THE FINANCES OF THE SOCIETIES.

FINANCES OF THE SOCIETIES.

SOCIETIES.	Amount received from the Commonwealth.	Income from Permanent Fund.	New Members and Donations.	All other Sources.	Receipts for the Year.	Premiums Offered.	Premiums and Gratuities Paid.	Current Expenses for the Year, not including Premiums and Gratuities.	Disbursements for the Year.	Indebtedness.	Value of Real Estate.	Value of Personal Estate.	Permanent Fund.
Massachusetts,	-	-	-	-	-	-	-	-	-	-	-	-	$77,002 47
Essex,	$600 00	$1,501 00	$232 25	$257 96	$2,591 21	$3,100 00	$1,759 75	$735 87	$2,495 62	-	$6,000 00	$1,000 00	19,333 05
Middlesex,	600 00	-	83 00	1,821 80	2,504 80	1,436 00	708 00	1,669 07	2,377 07	$19,000 00	14,000 00	-	6,000 00
Middlesex North,	600 00	267 25	71 00	1,478 89	2,417 14	1,206 00	749 50	1,401 67	2,452 17	1,450 00	20,000 00	300 00	20,000 00
Middlesex South,	600 00	-	133 40	499 23	1,232 63	884 50	392 25	573 06	965 31	12,500 00	18,000 00	-	12,000 00
Worcester,	600 00	550 50	55 00	941 97	2,147 47	7,823 00	6,182 00	2,103 53	8,285 53	37,000 00	125,000 00	5,000 00	93,000 00
Worcester West,	600 00	-	14 00	1,207 96	1,821 96	1,387 00	1,177 75	637 21	1,755 78	1,433 82	11,600 00	750 00	11,600 00
Worcester North,	600 00	-	309 35	1,550 02	2,459 37	1,276 50	849 55	1,540 65	2,377 50	11,600 00	16,000 00	-	-
Worcester N.-W.,	600 00	-	87 50	2,999 07	3,686 57	1,637 00	1,206 40	1,352 62	3,084 02	6,000 00	12,500 00	2,062 70	8,562 70
Worcester South,	600 00	-	115 00	2,861 32	3,576 32	1,472 00	1,291 30	1,868 04	4,162 34	116 10	13,500 00	1,000 00	13,500 00
Hampshire, Franklin and Hampden,	600 00	262 93	68 00	1,987 11	2,791 63	1,229 25	655 87	1,669 10	2,822 34	6,259 32	7,800 00	180 70	7,980 70
Hampshire,	600 00	-	162 99	657 11	1,420 10	780 00	637 05	515 92	1,297 97	780 87	4,100 00	150 00	3,469 13
Highland,	600 00	42 00	55 50	1,014 52	1,712 02	842 05	634 05	862 81	1,496 86	-	2,500 00	800 00	3,300 00
Hampden,	600 00	-	15 00	230 75	845 75	1,569 50	462 26	337 25	799 51	-	-	-	-
Hampden East,	600 00	-	122 88	778 12	1,501 00	1,148 25	844 72	642 75	1,487 47	-	5,000 00	-	5,000 00
Union,	600 00	-	138 37	787 52	1,525 89	1,396 50	887 98	724 64	1,612 62	-	5,200 00	2,064 73	7,264 73
Franklin,	600 00	60 00	156 00	958 32	1,774 32	906 75	756 16	824 45	1,830 86	800 00	10,000 00	1,000 00	11,000 00
Deerfield Valley,	600 00	-	134 40	573 57	1,307 97	700 00	601 55	561 42	1,305 66	665 13	8,080 00	100 00	8,080 00
Berkshire,	600 00	483 90	394 00	3,857 32	5,335 22	3,368 00	2,854 75	1,627 41	4,227 20	-	6,000 00	1,758 02	6,000 00
Hoosac Valley,	600 00		724 00	2,404 16	3,728 16	1,576 50	1,243 00	1,983 75	3,898 60	4,900 00	12,500 00	450 00	-

Housatonic,	600 00	62 70	241 34	4,806 17	5,710 21	3,571 00	2,951 00	2,963 39	5,914 00	-	8,500 00	11,023 08	18,986 02
Bristol,	600 00	-	269 77	9,137 16	10,006 93	4,500 00	3,301 93	4,796 63	15,784 89	15,000 00	57,000 00	300 00	42,000 00
Plymouth,	600 00	200 00	424 87	5,348 61	6,573 48	3,072 00	2,447 26	4,126 22	6,573 48	8,067 94	43,000 00	2,000 00	-
Hingham,	600 00	-	162 00	2,004 21	2,766 21	1,393 25	643 30	2,076 49	2,719 00	2,700 00	16,000 00	2,000 00	15,300 00
Marshfield,	600 00	-	25 00	1,704 15	2,334 15	1,154 00	850 95	1,962 43	2,813 38	4,212 04	12,056 92	1,592 78	9,437 66
Barnstable,	600 00	16 00	92 65	974 64	1,683 29	966 00	677 00	576 44	1,602 15	225 00	5,800 00	500 00	-
Nantucket,	600 00	40 00	21 00	333 91	994 91	1,175 00	613 89	519 14	933 03	600 00	3,000 00	200 00	3,200 00
Martha's Viney'd,	600 00	95 10	8 00	370 55	1,073 65	840 00	684 23	435 40	-	-	2,200 00	1,825 00	3,900 00
Amesbury and Salisbury,	200 00	40 48	34 00	328 50	602 98	280 00	205 50	268 68	474 18	-	-	500 00	1,172 15
Worcester S.-E.	-	-	-	-	-	-	-	-	-	-	-	-	-
	$16,400 00	$3,621 86	$4,350 27	$51,874 62	$76,125 34	$50,690 05	$36,268 95	$39,356 04	$85,548 54	$133,310 22	$445,336 92	$36,557 01	$407,083 61

PERMANENT FUND, — HOW INVESTED.

MASSACHUSETTS. — In bank-stock, bonds and mortgages.
ESSEX. — In bank-stock, farm, cattle-pens, tent and fixtures.
MIDDLESEX. — In land and buildings.
MIDDLESEX NORTH. — In land and buildings.
MIDDLESEX SOUTH. — In land, buildings, sheds, etc.
WORCESTER. — In real estate.
WORCESTER WEST. — In real estate.
WORCESTER NORTH. — In real estate.
WORCESTER NORTH-WEST. — In real estate and cash on hand.
WORCESTER SOUTH. — In land, buildings, etc.
HAMPSHIRE, FRANKLIN AND HAMPDEN. — In real estate and personal property.
HAMPSHIRE. — In real estate.
HIGHLAND. — In real estate, savings bank, cash, etc.
HAMPDEN. —
HAMPDEN EAST. — In land and buildings.
UNION. — In land, buildings, cash and notes.
FRANKLIN. — In real and personal estate.
DEERFIELD VALLEY. — In real estate.
BERKSHIRE. — In real estate.
HOOSAC VALLEY. — In real estate.
HOUSATONIC. — In real estate, bonds, notes and cash.
BRISTOL. — In real estate.
PLYMOUTH. — In real estate, fixtures, etc.
HINGHAM. — In land and buildings.
MARSHFIELD. — In land and buildings.
BARNSTABLE. — In real estate, government bonds and personal property.
NANTUCKET. — In land and buildings.
MARTHA'S VINEYARD. — In land and buildings.
AMESBURY AND SALISBURY. — In shares of Powow River Savings Bank.

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED.

SOCIETIES.	Total Amount offered for Management and Improvement of Farms, Orchards, etc.	Total Amount paid for Management and Improvement of Farms, Orchards, etc.	For Neat and Dairy Stock.	For Horses.	For all other Farm-Stock.	Total Amount offered for Live-Stock.	Total Amount paid out for Live-Stock.	For Cereals and Seed.	For Roots and Vegetables.	Total Amount offered for Grain and Root Crops.	Total Amount paid out for Grain and Root Crops.	For Fruits, Flowers, etc.	For Dairy-Products.	For Bread, Honey, and Preserved Fruits, etc.	Total Amount paid out under the head of Farm-Products.
Massachusetts,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Essex,	$350 00	$142 00	$487 00	$212 00	$161 50	$1,150 00	$809 00	$40 00	$210 50	$150 00	$80 00	$317 00	$53 00	$24 00	$470 00
Middlesex,	36 00	-	81 00	58 00	122 00	544 00	223 00	4 00	45 00	119 00	37 00	204 50	3 00	30 00	245 25
Middlesex North,	10 00	10 00	188 00	132 00	118 25	692 00	341 50	16 50	51 00	138 00	87 50	220 50	13 00	53 00	299 50
Middlesex South,	44 00	20 00	136 00	56 00	90 00	456 00	282 00	9 50	23 00	129 75	29 00	45 20	5 00	18 00	367 00
Worcester,	-	-	1,210 00	285 00	168 00	4,193 00	1,663 00	33 00	34 00	170 00	142 00	429 50	30 00	72 00	-
Worcester West,	65 00	20 00	302 00	134 00	70 50	645 00	543 50	5 50	14 05	74 50	19 55	36 15	30 00	12 00	117 25
Worcester North,	-	-	97 50	19 50	99 50	465 00	281 50	23 75	14 50	60 50	45 50	66 25	18 00	16 00	151 50
Worcester N.-W.,	22 00	22 00	215 00	129 00	143 25	808 25	471 45	51 00	19 00	111 00	63 99	41 75	17 00	11 00	130 73
Worcester South,	100 00	-	317 00	161 00	194 20	680 00	672 00	14 00	11 25	25 00	-	74 50	32 00	23 15	179 90
Hampshire, Franklin, and Hampden,	20 00	-	280 00	152 00	157 00	594 00	457 75	153 00	41 50	65 00	39 50	53 25	32 00	24 50	91 25
Hampshire,	-	-	93 00	78 00	147 00	422 00	261 50	11 00	23 50	68 00	34 50	97 50	8 00	16 00	151 00
Highland,	40 00	36 00	164 00	136 00	90 00	538 00	390 00	8 50	19 50	43 00	28 00	14 50	7 50	6 30	61 80
Hampden,	230 00	9 50	131 00	73 00	76 00	798 50	237 00	12 25	11 75	216 00	49 13	119 25	5 00	13 50	129 00

Hampden East,	122 00	24 00	155 00	122 00	110 50	475 00	387 50	16 25	7 80	77 00	24 00	50 00	7 00	12 00	93 50
Union, . .	16 00	7 50	196 50	103 00	160 50	741 50	431 00	16 50	7 50	56 00	38 00	41 25	14 00	8 55	99 55
Franklin, . .		-	143 00	121 99	238 50	597 00	483 16	11 00	17 25	48 00	33 50	91 75	15 00	18 50	124 50
Deerfield Valley,		-	176 00	113 00	120 00	481 00	409 00	6 75	14 50	24 25	25 00	26 45	15 00	18 50	90 20
Berkshire, . .	159 00	146 00	436 00	212 00	300 50	1,321 00	948 50	227 00	130 00	451 00	413 00	143 50	70 00	47 00	617 50
Hoosac Valley, .	60 00	48 00	97 00	164 00	215 00	656 00	476 00	147 25	73 50	235 00	220 75	91 25	47 00	37 00	396 00
Housatonic, .	168 00	114 00	383 00	272 00	440 00	1,969 00	1,532 00	377 00	141 00	572 00	530 00	161 00	65 00	60 00	890 00
Bristol, . .	215 00	114 00	560 00	171 00	249 00	1,550 00	960 00	16 00	90 00	275 00	98 00	121 00	38 00	27 00	390 00
Plymouth, . .	146 00	60 00	395 00	219 00	205 00	1,066 00	809 00	100 00	62 00	249 00	162 00	124 80	55 00	90 75	432 55
Hingham, . .	194 00	9 00	147 00	61 75	110 05	605 25	318 80	15 00	34 00	177 00	49 00	138 50	13 25	25 40	226 15
Marshfield, . .	85 00	31 00	186 00	68 50	82 75	448 00	337 25	12 00	69 25	94 00	81 00	81 95	21 00	36 00	219 95
Barnstable, .	-	13 00	90 00	36 00	191 25	336 00	317 25	8 00	50 75	174 00	66 10	75 50	16 00	27 00	226 35
Nantucket, . .	74 00	-	174 50	65 50	57 25	587 00	292 25	19 50	37 00	147 00	56 50	45 00	15 00	13 00	389 50
Martha's Viney'd,	57 00	18 00	114 15	41 00	97 20	341 50	239 40	62 50	72 30	157 00	-	67 80	21 25	43 45	-
Amesbury and Salisbury, .	-	-	-	-	4 00	12 00	4 00	6 00	26 00	70 00	36 50	62 00	1 00	2 00	101 75
Worcester S.-E.,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$2,213 00	$844 00	$6,954 65	$3,396 24	$4,218 70	$23,172 00	$14,578 31	$1,422 75	$1,351 40	$4,176 00	$2,489 02	$3,041 60	$667 00	$785 60	$6,691 68

Analysis of Premiums and Gratuities Awarded — *Concluded.*

MISCELLANEOUS.

SOCIETIES.	For Agricultural Implements.	Offered for raising Forest-Trees.	For Experiments on Manures.	Amount awarded for Objects strictly Agricultural not already specified.	Amount awarded and paid out for Trotting-Horses.	For Objects not strictly Agricultural: Domestic Manufactures.	Number of Persons who received Premiums and Gratuities.
Massachusetts,	-	-	-	-	-	-	-
Essex,	$28 00	$40 00	$25 00	-	-	-	312
Middlesex,	-	50 00	-	-	$500 00	$106 00	192
Middlesex North,	3 00	-	-	-	-	3 60	219
Middlesex South,	8 00	30 00	-	-	171 00	50 35	111
Worcester,	45 00	-	-	-	1,700 00	519 00	363
Worcester West,	8 25	30 00	10 00	-	480 00	78 70	204
Worcester North,	15 00	25 00	-	-	200 00	159 95	280
Worcester North-west,	10 00	30 00	-	-	520 00	77 40	169
Worcester South,	7 45	35 00	-	-	350 00	-	208
Hampshire, Franklin, and Hampden,	16 00	20 00	-	-	450 00	90 50	131
Hampshire,	-	8 00	-	$14 00	145 00	141 05	161
Highland,	2 50	-	-	-	22 00	121 75	195
Hampden,	26 00	30 00	15 00	21 50	-	58 00	101
Hampden East,	15 25	25 00	-	-	270 00	54 97	154
Union,	3 75	-	-	8 00	230 00	111 30	174
Franklin,	-	10 00	-	-	-	139 00	200
Deerfield Valley,	-	-	-	-	-	102 35	210
Berkshire,	40 00	-	-	-	669 00	433 75	640
Hoosac Valley,	28 50	-	10 00	32 50	905 00	264 50	250
Housatonic,	-	-	-	56 00	445 00	406 00	467
Bristol,	50 00	23 00	60 00	-	1,702 00	456 50	490
Plymouth,	11 00	60 00	-	10 00	933 00	222 75	396
Hingham,	-	50 00	-	-	-	89 35	321
Marshfield,	6 00	50 00	-	-	164 00	127 30	456
Barnstable,	-	7 00	-	-	80 00	162 15	413
Nantucket,	-	13 00	15 00	-	-	-	192
Martha's Vineyard,	2 75	11 00	10 00	-	-	-	190
Amesbury and Salisbury,	10 00	-	-	-	-	89 75	163
Worcester South-east,	-	-	-	-	-	-	-
	$336 45	$547 00	$145 00	$142 00	$9,936 00	$4,065 97	7,362

OFFICERS OF THE AGRICULTURAL SOCIETIES, 1883.

MASSACHUSETTS.

President — THOMAS MOTLEY of Jamaica Plain.
Secretary — E. F. BOWDITCH of Framingham.

ESSEX.

President — BENJAMIN P. WARE of Marblehead.
Secretary — CHARLES P. PRESTON of Danvers.

MIDDLESEX.

President — JOHN CUMMINGS of Woburn.
Secretary — WILLIAM H. HUNT of Concord.

MIDDLESEX SOUTH.

President — CHARLES A. TILTON of Ashland.
Secretary — C. A. HEMENWAY of Framingham.

MIDDLESEX NORTH.

President — A. C. VARNUM of Lowell.
Secretary — E. T. ROWELL of Lowell.

WORCESTER.

President — CHARLES B. PRATT of Worcester.
Secretary — G. H. ESTABROOK of Worcester.

WORCESTER WEST.

President — HENRY S. MINER of Phillipston.
Secretary — CHARLES H. FOLLANSBY of Barre.

WORCESTER NORTH.

President — A. GOODRICH of Fitchburg.
Secretary — F. C. CURRIER of Fitchburg.

WORCESTER NORTH-WEST.

President — J. H. LEE of Boston.
Secretary — E T. LEWIS of Athol.

WORCESTER SOUTH.

President — BAINBRIDGE DOUTY of Charlton.
Secretary — C. V. COREY of Sturbridge.

WORCESTER SOUTH-EAST.

President — VELOROUS TAFT of Upton.
Secretary — CHAS. E. CROCKER of Uxbridge.

HAMPSHIRE, FRANKLIN, AND HAMPDEN.

President — JONATHAN D. PORTER of Hatfield
Secretary — L C. FERRY of Northampton.

HAMPSHIRE.

President — WM. W. SMITH of Amherst.
Secretary — FRANK E. PAIGE of Amherst.

HIGHLAND.

President — WM. H. SNOW of Becket.
Secretary — JONATHAN McELWAIN of Middlefield.

HAMPDEN.

President — ETHAN BROOKS of West Springfield.
Secretary — J. N. BAGG of West Springfield.

HAMPDEN EAST.

President — DR. WM. HOLBROOK of Palmer.
Secretary — O. P. ALLEN of Palmer.

UNION.

President — WM. M. LEWIS of Blandford.
Secretary — ENOS W. BOISE of Blandford.

FRANKLIN.

President — ANSON K. WARNER of Greenfield.
Secretary — SAM'L D. CONANT of Greenfield.

DEERFIELD VALLEY.

President — C. B. MAYHEW of Charlemont.
Secretary — M. M. MANTOR of Charlemont.

BERKSHIRE.

President — S. W. BOWERMAN of Pittsfield.
Secretary — WM. H. MURRAY of Pittsfield.

HOOSAC VALLEY.

President — WM. S. JOHNSON of North Adams.
Secretary — H. CLAY BLISS of North Adams

HOUSATONIC.

President — GEORGE KELLOGG of Sheffield.
Secretary — HENRY T. ROBBINS of Great Barrington.

BRISTOL.

President — THEODORE DEAN of Taunton.
Secretary — D. L. MITCHELL of Taunton.

PLYMOUTH.

President — JOHN LANE of East Bridgewater.
Secretary — LAFAYETTE KEITH of Bridgewater.

HINGHAM.

President — EBED L. RIPLEY of Hingham Centre.
Secretary — W. H. THOMAS of Hingham.

MARSHFIELD.

President — GEO. M. BAKER of Marshfield.
Secretary — FRANCIS COLLAMORE of Pembroke.

BARNSTABLE.

President — AZARIAH ELDRIDGE of Yarmouth Port.
Secretary — F. PERCY GOSS of Barnstable.

NANTUCKET

President — RICHARD E. BURGESS of Nantucket.
Secretary — JOHN F. BROWN of Nantucket.

MARTHA'S VINEYARD.

President — JOHN W. MAYHEW of Chilmark.
Secretary — B. T. HILLMAN of Chilmark.

AMESBURY AND SALISBURY.

President — J. HENRY HILL of Amesbury.
Secretary — A. H. FIELDEN of Salisbury.

AGRICULTURAL EXHIBITIONS, 1883.

AMESBURY AND SALISBURY at *Newburyport*, Oct. 2 and 3.
BARNSTABLE at *Barnstable*, Sept. 25 and 26.
BERKSHIRE at *Pittsfield*, Oct. 2, 3 and 4.
BRISTOL at *Taunton*, Sept. 25, 26 and 27.
DEERFIELD VALLEY at *Charlemont*, Sept. 20 and 21.
ESSEX at *Haverhill*, Sept. 25 and 26.
FRANKLIN at *Greenfield*, Sept. 27 and 28.
HAMPDEN at *Chicopee*, Sept. 25, 26 and 27.
HAMPDEN EAST at *Palmer*, Sept. 18 and 19.
HAMPSHIRE at *Amherst*, Sept. 20 and 21.
HAMPSHIRE, FRANKLIN AND HAMPDEN at *Northampton*, Oct. 3, 4 and 5.
HIGHLAND at *Middlefield*, Sept. 13 and 14.
HINGHAM at *Hingham*, Sept. 25 and 26.
HOOSAC VALLEY at *North Adams*, Sept. 18 and 19.
HOUSATONIC at *Great Barrington*, Sept. 26, 27 and 28.
MARSHFIELD at *Marshfield*, Sept. 12, 13 and 14.
MARTHA'S VINEYARD at *West Tisbury*, Oct. 2 and 3.
MIDDLESEX at *Concord*, Sept. 25, 26 and 27.
MIDDLESEX NORTH at *Lowell*, Sept. 25 and 26.
MIDDLESEX SOUTH at *Framingham*, Sept. 18 and 19.
NANTUCKET at *Nantucket*, Sept. 5 and 6.
PLYMOUTH at *Bridgewater*, Sept. 19, 20 and 21.
UNION at *Blandford*, Sept. 19, 20 and 21.
WORCESTER at *Worcester*, Sept. 20 and 21.
WORCESTER NORTH at *Fitchburg*, Sept. 25 and 26.
WORCESTER NORTH-WEST at *Athol*, Oct. 2 and 3.
WORCESTER SOUTH at *Sturbridge*, Sept. 13 and 14.
WORCESTER SOUTH-EAST at *Milford*, Sept. 25, 26 and 27.
WORCESTER WEST at *Barre*, Sept. 27 and 28.

APPENDIX.

I.

REPORT — EXPERIMENT STATION.

To the Board of Control of
The State Agricultural Experiment Station.

GENTLEMEN: — Receiving the notice of my appointment as director of the State Agricultural Experiment Station at Amherst towards the close of the past year, I have confined my attention, on account of the lateness of the season, to the chemical examination of the various materials sent to the station for that purpose; and to an inquiry into the resources of various departments of the college, for the purpose of ascertaining the extent of assistance the State Agricultural College may be able to render to the Experiment Station.

The chemical examinations comprise the following substances: —

Two samples of eel-grass, New Bedford, Mass.
One sample of swamp peat, Harwich, Mass.
One sample of a marine deposit, Harwich, Mass.
One sample of raw wool, Clinton, Mass.
One sample of ashes, Boston, Mass.
One sample of ashes, Northampton Mass.
Two samples of Canada ashes, Sunderland, Mass.
Two samples of Canada ashes, Amherst, Mass.
Six samples of chemically prepared leather refuse, Boston, Mass.
Two samples of green corn for ensilage, Marblehead, Mass.
Two samples of corn ensilage, Marblehead, Mass.
A stomach of a pig, South Hadley, Mass.
A stomach of a cow, Egremont, Berkshire County, Mass.
Cotton-seed meal for feeding, Hatfield, Mass.
Cotton-seed meal for fertilizer, Hatfield, Mass.

A detailed statement of the analytical results accompanies this communication under the heading, "Report of the Chemist."

Suitable rooms have been secured in the chemical department of the State Agricultural College for the accommodation of the chemist of the station and his assistants. These apartments have been supplied with gas for illumination, and especially for heating purposes. The gas is made from gasoline and air, and the works for its production have been constructed under a special contract by direction of the committee appointed by the Board for that purpose. The gasworks and burners are substantial, and the gas produced is of a good and serviceable quality for the various operations for which it is designed. It is estimated that one thousand cubic feet of gas will not exceed one dollar in cost. Two gas-burning stoves, for elementary analysis, are still among the wants seriously felt in this connection. As the ordinary gas-burning stoves require alterations to use the gas produced by gasoline, an expenditure of from seventy to seventy-five dollars will still be necessary to provide the chemical laboratory with an indispensable outfit for quantitative analytical work of first importance. Some chemical apparatus and a limited quantity of chemicals, to meet the first requirements of the laboratory, were secured from the stock of the State college and such other sources as could be had without cash payment.

I felt also obliged to engage, since Nov. 15, 1882, an experienced graduate of the college, Joseph L. Hills of Boston, of the class of '81, who, since his graduation, has pursued a post-graduate course in the chemical department of the college, to assist in the chemical laboratory; his services have been secured until the first of February, 1883, at a compensation of five dollars per week. A larger supply of chemicals and of apparatus for general chemical operations has just been received. The chemical laboratory is thus supplied for from four to six months hence, with such materials as are daily needed to carry on its ordinary work without any serious interruption. The bills covering these transactions are enclosed and are accompanied with a compiled statement of the various items.

REPORT OF THE CHEMIST.

Eel-grass.

(Sent on by the South Bristol Farmers' Club, New Bedford, Mass.)

I. Taken from water, March, 1882.

II. Taken from water, October, 1881, and left to the action of air, rain and sun until March, 1882.

	I.	II.
Moisture (as sent on),	45.61 per cent.	25.17 per cent.
Volatile and organic matter,	79.61 "	89.18 "
Ash constituents,	20.39 "	10.81 "
Nitrogen in organic matter,	.70 "	.96 "
Potassium oxide,	1.61 "	.21 "
Sodium oxide,	2.51 "	.74 "
Calcium oxide,	1.56 "	2.70 "
Magnesium oxide,	.09 "	.12 "
Ferric oxide,	.31 "	.17 "
Phosphoric acid,	.41 "	.22 "
Insoluble matter,	.46 "	1.66 "

The composition of the seaweeds in their natural condition is somewhat modified by adhesive sea-shells, sea-water, etc.; not two samples would strictly agree in composition. Time and exposure modify organic and inorganic constituents; the alkalies and some phosphates, are liable to be washed out in part by rain; starchy materials, etc., are decomposed apparently at a higher rate than nitrogenous organic matter; lime and magnesia compounds increase usually in rate by keeping in open air; potash and soda decrease. The entire amount of potash, phosphoric acid and nitrogen contained in the organic vegetable matter is finally available.

Five cents per pound for potash, six cents per pound for phosphoric acid, and twenty-four cents per pound for nitrogen is their present market price.

The chemicals in eel-grass are available in the same ratio as the disintegration advances, and as eel-grass decays very slowly, on account of its saline admixture under most circumstances, its agricultural value in general is not so fully appreciated as in those materials of equal composition where circumstances favor disintegration. Additions of lime will prove beneficial in that direction.

Peat.

(Sent on from Harwich, Mass.)

Moisture,	78.26	per cent.
Dry matter,	21.74	"
Total ash,	1.31	"
Insoluble matter,	1.08	"
Ash soluble in acids,	.23	"
(Ash soluble in acids consisted of traces of lime, magnesia and phosphoric acid.)		
Nitrogen in wet peat,	.41	"
Nitrogen in air-dry peat (31 per cent. water),	1.30	"
Nitrogen in perfectly dry peat,	1.89	"

This sample is a fair article of its kind; exposure to the air and some addition of lime tends to improve its fitness as an absorber and a source of nitrogen. Light soils benefit most by its application.

Marl.

(Sent on from Harwich, Mass.)

Moisture,	10.80	per cent.
Organic and volatile matter,	32.26	"
Ash constituents,	67.74	"
Mineral matter soluble in acids,	9.69	"
Mineral matter soluble in acids contained:		
Calcium oxide,	.433	"
Alumina, iron and phosphoric acid (traces),	5.55	"
Magnesia,	.57	"
Alkalies (traces of potassium oxide),	3 14	"

This material contains a small amount of valuable plant constituents, and can, in exceptional cases only, compensate for the cost of transportation.

Raw Wool.

(Fleece from Argentine Republic sent on for examination from Clinton, Mass.)

Moisture,	6.95	per cent.
Organic and volatile matter,	92.46	"
Ash constituents,	7.54	"
Insoluble matter,	3.63	"
Fatty matter (ether abstract),	3.92	"
Nitrogen,	12.88	"

One hundred parts of wool contained washings —

	With Acidulated Water.	With Hot Water.
Potassium oxide, ...	4.20 per cent.	3.92 per cent.
Sodium oxide, ...	.40 "	.49 "
Calcium oxide, ...	.61 "	.28 "
Magnesium oxide, ...	.20 "	none.
Ferric oxide, ...	.133 "	"
Phosphoric acid, ...	traces.	"

The amount of potash removed from the wool by mere washing is quite large, and imparts to the resulting solution a considerable value for fertilizing purposes. To utilize the water used for the washing of raw wool for the irrigation of meadow land, etc., when practicable, deserves some trial.

I. and II. *Ashes.*

I. Sent on for examination from Boston, Mass.
II. Sent on for examination from Northampton, Mass.

	I.	II.
Moisture, ...	1.78 per cent.	2.26 per cent.
Potassium oxide, ...	2.90 "	3.26 "
Sodium oxide, ...	not determ.	1.83 "
Calcium oxide, ...	4.84 per cent.	20.29 "
Magnesium oxide, ...	.315 "	not determ'd.
Phosphoric acid, ...	1.55 "	1.28 per cent.
Insoluble matter, ...	63.93 "	35.15 "

I. The source of this ash is not stated; it is apparently a mixture of coal ashes and wood ashes; its agricultural value is but one-half that of a good quality of wood ashes.

II. This material is of a similar quality as No. I.; the depreciation in commercial value was, in this case, mainly due to the presence of a comparatively large amount of coal.

III. and IV. *Hard Wood Ashes.*

(Sent on from Sunderland, Mass.)

	III.	IV.
Moisture, ...	24.50 per cent.	16.66 per cent.
Calcium oxide, ...	33.13 "	32.25 "
Potassium oxide, ...	4.77 "	4.97 "
Phosphoric acid, ...	1.49 "	1.66 "
Insoluble matter, ...	8.50 "	10.45 "

V. and VI. *Hard Wood Ashes.*

(Sent on for examination from Amherst, Mass.)

	V.		VI.	
Moisture,	18.70	per cent.	9.30	per cent.
Organic and volatile matter,	25.99	"	21.69	"
Ash constituents,	74.01	"	78.31	"
Phosphoric acid,	1.10	"	.78	"
Calcium oxide,	30.60	"	34.91	"
Ferric oxide,	2.84	"	–	
Potassium oxide,	4.61	"	6.50	"
Insoluble matter,	11.06	"	9.30	"

Samples III., IV., V., VI., represent the average quality of Canada wood ashes sold in our section of the Connecticut River Valley at 33 to 35 cents per bushel; they are worth the price asked for them.

Chemically Prepared Leather Refuse.

(Sent on by John E. Russell, Secretary of the State Board of Agriculture, Boston, Mass.)

	I.	II.	III.	IV.	V.	VI.	
Moisture at 100° C.,	10.30	8.60	10.50	10.20	11.80	8.50	per ct
Ash constituents,	.87	–	–	–	–	–	
Volatile and organic matter,	99.13	–	–	–	–	–	
Nitrogen in organic matter,	8.03	5.89	6.58	7.80	7.23	8.84	per ct

All the samples were of a more or less dark-brown color, resembling certain varieties of dried blood; they varied from 5.89 to 8.84 per cent. in nitrogen. An attempt has been made of late to introduce this material into our markets as a nitrogen resource for fertilizer. Its comparative value for that purpose has never been ascertained, and its use ought to be discouraged; for, as far as experimental observations in the field have shown, its effect on crops is very doubtful. Some experiments have been inaugurated here for the purpose of ascertaining whether it is possible by some simple preparatory treatment, to render its nitrogen active. To use this article in fertilizers in its present condition, without giving due notice to the farming community, is equal to a fraud.

Green Corn for Ensilage.

(Sent by B. P. Ware, Esq., of Marblehead, Mass., Oct. 10, 1882.)

	I.	II.
Moisture at 100° C.,	84.880 per ct.	87.974 per ct.
Dry matter,	15.120 "	12.026 "
Ash constituents,	1.041 "	1.155 "
Crude cellulose,	4.681 "	4.037 "
Fat (ether abstract),	.109 "	.233 "
Non-nitrogenous extract matter,	8.054 "	5.299 "
Nitrogenous matter,	1.233 "	1.302 "

Calculation per ton of two thousand pounds: —

	I.	II.
Water,	1,697.60 lbs.	1,759.48 lbs.
Dry matter,	320.40 "	240.52 "
Ash constituents,	20.82 "	23.10 "
Crude cellulose,	93.68 "	80.74 "
Fat (ether abstract),	2.18 "	4.66 "
Non-nitrogenous extract matter,	161.08 "	105.98 "
Nitrogenous matter,	24.66 "	26.04 "

Corn Ensilage.

(Sent on by B. P. Ware, Esq., Marblehead, Mass., Dec. 28, 1882.)

	I.	II.
Moisture at 100° C.,	84.1253 per ct.	87.8825 per ct.
Dry matter,	15.8747 "	12.1175 "
Ash constituents,	1.1562 "	1.0540 "
Crude cellulose,	6.0033 "	4.0351 "
Fat (ether abstract),	.3628 "	.3055 "
Non-nitrogenous abstract matter,	7.0455 "	5.4686 "
Nitrogenous matter,	1.3069 "	1.2543 "

Calculation per ton of two thousand pounds: —

	I.	II.
Water,	1,682.506 lbs.	1,757 650 lbs.
Dry matter,	317.494 "	242 350 "
Ash constituents,	23.124 "	21.080 "
Crude cellulose,	120.066 "	80.702 "
Fat (ether abstract),	7.256 "	6.110 "
Non-nitrogenous extract matter,	140.910 "	109.372 "
Nitrogenous matter,	26.138 "	25.086 "

Green Corn and Ensilage.

	Corn No. 1.	Ensilage No. 1.
Moisture at 100° C.,	84.880 per ct.	84.1253 per ct
Dry matter,	15.120 "	15.8747 "
Ash constituents,	1.041 "	1.1562 "
Crude cellulose,	4.684 "	6.0033 "
Fat (ether abstract),	.109 "	.3628 "
Non-nitrogenous extract matter,	8.054 "	7.0455 "
Nitrogenous matter,	1.233 "	1.3069 "

	Corn, No. 2.	Ensilage, No. 2.
Moisture at 100° C.,	87.974 per ct.	87.8825 per ct
Dry matter,	12.026 "	12.1175 "
Ash constituents,	1.155 "	1.0540 "
Crude cellulose,	4.037 "	4.0351 "
Fat (ether abstract),	.233 "	.3055 "
Non-nitrogenous extract matter,	5.299 "	5.4686 "
Nitrogenous matter,	1.302 "	1.2543 "

These analyses give a good idea of a well-kept silo-product. To determine the exact amount of loss incurred by the operation cannot be definitely stated, without having a chance to assist in the preparation of the samples; the acid reaction of the ensilage points towards a loss of saccharine constituents. The corn ought to be weighed when entering the silo, as well as the ensilage.

Cotton-seed Meal (Feed).

(Sent on by E. S. Warner, Hatfield, Mass.)

Moisture at 100° C.,	7.09 per cent.
Dry matter,	92.91 "
Ash constituents,	8.50 "
Crude cellulose,	9.78 "
Fat (ether abstract),	12.64 "
Non-nitrogenous extract matter,	23.30 "
Nitrogenous matter,	38.69 "

Composition per ton of two thousand pounds: —

Water,	141.80 lbs.
Dry matter,	1,858.20 "
Ash constituents,	170.00 "
Crude cellulose,	195.60 "
Fat (ether abstract,)	252.80 "
Non-nitrogenous extract matter,	466.00 "
Nitrogenous matter,	773.80 "

This article is of good quality, and was obtained by bolting a coarser cotton-seed meal; eighty-one pounds of the above kind was obtained from one hundred pounds of the latter; the coarse portion — nineteen per cent. — has been tested with reference to its fitness as a fertilizer. The following analysis refers to this material: —

Coarse Portion of Cotton-Seed Meal for Fertilizing Purposes.

(Sent on by E. S. Warner, Hatfield, Mass.)

Moisture at 100° C.,	8.975	per cent.
Organic and volatile matter,	93.465	"
Ash constituents,	6.535	"
Nitrogen in organic matter,	5.900	"
Potassium oxide,	1.797	"
Calcium oxide,	0.263	"
Magnesium oxide,	0.223	"
Phosphoric acid,	2.341	"
Insoluble matter,	1.784	"

Valuation per ton of two thousand pounds: —

46.82 pounds of phosphoric acid,	$2 81	(6 cts.)
35.94 pounds of potassium oxide,	1 80	(5 cts)
118.00 pounds of nitrogen,	23 60	(20 cts.)
	$28 21	

The cotton-seed meal, from which the above stated coarse portion was separated — nineteen per cent. coarse versus eighty-one per cent. fine — had been bought by the ton at twenty-nine dollars at Northampton, Mass.

Stomach of a Pig.

(Sent on from South Hadley, Mass.)

The animal had died without any apparent cause, and under symptoms but very little understood. The request was to test for any mineral poison. None was found.

Stomach of a Cow.

(Sent on from Egremont, Berkshire County, Mass.)

A part of the stomach was sent, with the special instruction to test for paris green. Neither copper nor arsenic could be detected.

Samples of tobacco refuse, broom-corn refuse, corn-meal (fine), corn-meal with cobs, rye bran, wheat bran, cotton-seed meal (coarse), have been sent on of late and are waiting for analysis.

Without any intention to anticipate in any particular direction the decision of the Board, I take the liberty to enumerate briefly a series of subjects for future experimental investigation. The selection of the various topics has been controlled by two considerations: *First*, to comply as far as practicable at the outset with the special direction of the late legislative enactment regarding the particular work of the experiment station. (See sect. 5 of "An Act to establish an Agricultural Experiment Station, chap. 212, Laws and Resolves, 1882.) *Second*, to turn the pecuniary and local resources of the experiment station to good account, as far as the solution of the leading agricultural questions of the day is concerned.

Some of the subjects named below have been already for several years experimentally investigated upon the college grounds, and need but little assistance to be brought to a satisfactory termination; others cause only an outlay at the beginning, and may be carried on with much benefit for years without any particular subsequent expense; while several, if at all selected, derive additional interest from an early beginning of the observation. To approximate intelligently the pecuniary wants of the experiment station for the first year renders it in my opinion advisable to base the desired specification of necessary appropriations on some definite plan of operation, if for no other purpose than to assist in a judicious distribution of the means on hand.

The subsequent statement is based on a careful consideration of our local resources, and of the character of the work expected. It embodies, also, the views of Prof. Miles and Prof. Maynard regarding their special work and wants. Both gentlemen concur in the opinion that a series of experiments like those mentioned, or of a similar character, may be efficiently provided for at an expense not much varying from the sums specified below. A detailed description of the various experiments has been omitted for obvious reasons.

List of Experiments proposed for the present Year (1883).

1. Relation of crops to manure, and to soil constituents, and to the conditions, which involve a loss of fertilizing material by drainage. This experiment would require from twelve to fifteen plats, of from one-tenth to one-fifth of an acre each, in size. The whole land to be well underdrained, to enable the collection of the drainage waters for chemical analysis.

2. Experiments to illustrate the relative manurial value of commercial fertilizers, and of barnyard manure of equivalent composition; and to investigate the economy of buying feed for the farm live-stock, instead of commercial fertilizer for the improvement of the farm lands for the production of farm crops. Six feeding-boxes are needed for making and collecting the manures.

3. Feeding experiments with pigs — to ascertain the relative value of skim-milk and of whole milk, alone and when mixed with other stronger articles of food, as corn-meal, cotton-seed meal, etc., conforming to definite fodder rations. From twelve to twenty pens are desired to isolate the animals; the trial to begin with young animals early in the spring.

4. Feeding experiments with cows; to study the influence of various combinations of our staple articles of fodder on the quality, and the quantity of milk; some of the fodder might be raised on the lands set apart for the experiment station.

5. Comparative tests of green fodder, dry fodder, and the products of the silo, regarding the economy of the operation.

6. Cultivation of some new forage crops for green fodder. Some leguminous plants, which for several years have been successfully raised upon experimental plats of the college, are proposed to be raised with rye and oats to increase their nutritive ratio.

7. Effect of different articles of plant food upon the quality and the quantity of fruits, time of ripening, and

hardiness of plant. A continuation of experiments already for years carried on.

8. Comparative tests of new varieties of fruit. An enlargement of existing local collections.

9. Diseases of fruit trees; investigation of causes and remedies. A continuation and extension of previous studies upon the college grounds.

10. Influence of the stock upon the scion in budding and grafting.

11. Testing the character of the seeds in our market.

12. Destruction of injurious insects.

It is proposed to assign the six first-named experiments to the special supervision of Prof. Miles, the remaining ones to the care of Prof. Maynard, who for several years past has taken part in several of a similar character. The chemical department intends to assist in the majority of experiments to the full extent of its resources; to carry on the examination of all subjects requiring an analytical chemical investigation for an intelligent interpretation of experimental results; and to attend also to the analysis of such substances as may be sent on for that purpose, — as far as they come within the duties of the station.

To enter upon a course of experiments similar to the one previously described, requires at the outset, efficient provisions for barns, store-rooms, stables, land, animals for trials, fodder, farm implements, commercial fertilizers, scientific apparatus, chemicals, skilled assistants and farm laborers. I have taken pains to ascertain, as far as practicable, the approximate sum needed to supply the most important wants. An enumeration of the sums to provide for the various items is enclosed under the heading — "Appropriations recommended for the year 1883."

It appears, from a careful examination of an experienced house-carpenter, that the barn with wing, and the front portion of the dwelling-house located at the north end of the college farm, can be repaired and efficiently refitted for the experimental work at a moderate outlay. The barn and wing are, as far as their frames are concerned, in very good condition; they are spacious, and well-adapted for stables,

pens, and store-rooms for crops. One thousand dollars, it is estimated, are sufficient to fit up the interior for stables, with the necessary arrangements for the feeding experiments, etc.; to re-shingle the roof, and make such other improvements as are desirable to give the buildings a more finished appearance. The farm dwelling is in a less satisfactory condition than the barn; yet it is stated by experts, that the interior of the main part of the building can be put in good order to serve still for years for offices and collection rooms, etc., at an expense not exceeding six hundred dollars.

The main part of the building is sound in timber. The proposed alterations are to take down the large chimney in the centre of the front building; to re-sill the latter on the south and west sides; to raise the entire front structure one foot; to make the cellar more serviceable, and to remove the western lower portion of the structure entirely.

From six to eight acres of land adjoining the farm buildings would suffice for the first year at least, to carry out the above-stated field experiments, whilst from one to two acres in the vicinity of the plant-house would furnish a sufficient area to experiment with fruits and garden plants, and to enlarge the experimental plats of forage plants on the college ground, for the purpose of raising some noted new forage crops on a larger scale.

As it is assumed that the team-work and the farm live-stock for experiments can be furnished from the college farm at a reasonable compensation, and that the field products of the lands of the experiment station will contribute towards the expenses incurred in this connection, no specifications regarding these items have been made.

Four efficient and reliable graduates of the college, engaged in a post-graduate course could be advantageously employed in the field and the laboratory.

Two graduates, efficient in chemistry, will find at once continuous employment in the chemical laboratory; one ought to be assigned to assist Prof. Miles whenever called on, and one to perform similar duties, under the direction of Prof. Maynard.

As a different degree of efficiency as well as a different time of engagement will entitle to a different compensation,

it seems desirable, for the first year at least, to appropriate a definite sum to secure the necessary assistance, and to leave to the officer in charge the judicious distribution of the sum set apart for that purpose.

An allowance of one thousand and forty dollars would answer for an average compensation of five dollars per week; a very moderate outlay compared with customary compensation under similar circumstances.

Some instructions for the guidance of the director are also desirable, regarding the examination of substances sent to the station for that purpose. Although it is very desirable to render the experiment station popular by attending to the requests made in that direction; it seems desirable, on account of the limited resources of the institution, to distinguish between personal and general interests, and to adopt some rule for action.

Part payment of expenses of examination, or an endorsement by officers of the local agricultural society, and obligation to pre-pay express charges are customary restrictions; the payments received to be added to the funds of the station.

As the law obliges the director of the station to publish from time to time the results of current examinations, it will be necessary to decide upon the course to pursue.

It is customary in other experiment stations to furnish the agricultural papers of the State with printed statements, whenever work of general interest to the farming community calls for an early information.

C. A. GOESSMANN,
Director Mass. State Agricultural Experiment Station.

AMHERST, Jan. 25, 1883.

II.

REPORT ON THE TWENTY-SEVENTH CATTLE SHOW OF NANTUCKET.

As the appointed delegate from the State Board of Agriculture, I attended the twenty-seventh cattle show and fair of the Nantucket Agricultural Society on the island, Sept. 6 and 7, 1882.

I arrived there on the second day before the fair, that I might spend a day in going over the island to gather such facts as I could of the condition of its agriculture, and to see what improvements had been made therein in the twenty years since I visited it on a similar mission.

The island of Nantucket is about thirty miles from the main land, about fifteen miles in length, and from three to four in width, containing about fifty square miles, of which nearly fifteen thousand acres are unimproved and unenclosed.

That the island was once well wooded is a matter of history; but it is not within the memory of any living man that any trees have existed there, though the trunks and stumps of undecayed trees, occasionally found in the peat beds, are unimpeachable witnesses to the former existence of woodland.

There were returned in 1875 one hundred and seventy-three acres of woodland, which was pine, resulting from the planting by public-spirited men, about forty years since, of large tracts with the seed of the common pitch-pine (*pinus rigida*), which were generally strewn in light furrows from four to eight feet apart, and which, for years, in spite of browsing, fierce winds, and destroying fires, flourished and grew successfully. In late years a sort of blight, in the form of a fungoid growth, has attacked the foliage of a large number, which ultimately destroys the trees, and

many thousands have died and are dying, greatly to the discouragement of those who enterprised such a noble public work, and to the people of the island.

There is naturally much grass on the island, and in many places where it had been sown after hoed or grain crops, were fine fields of grass, which showed a soft, elastic feel under the foot, indicating a good sod, and this is noticeable all over the island, in fence corners and among the scrub oaks so plentiful everywhere, showing a natural adaptability for grass-growing wherever protected.

I saw as thrifty and well filled young stock picking the grass among these oaks as could be found in any pastures on the main land. Sheep were also feeding and thriving. Of all places in New England, I know of no spot where sheep husbandry might be practised with equal ease and safety and profit as on Nantucket, and the islanders themselves are the only ones who do not appreciate it.

With no frost till the very last of November, and a good bite of grass early in April, they ought to market one hundred and twenty-five lambs to a hundred ewes at a great deal less than it costs us in Franklin County.

With so mild a climate, and good hay, and some grain, they could easily have early lambs by Easter, worth $12 per head, and from that till May many selling for $7 and $8 each — while their grass lambs, which would probably be their best show, at $5 and $4 each, would get into market fat a full month earlier than ours.

In a county where they can pasture eight months out of the twelve, the wool of a good flock of sheep will pay for their keeping through the year, except a little extra feed for them when with the lambs, so that, except for the natural deterioration of the ewes, the lambs are almost a net profit. We, in Franklin, would esteem ourselves fortunate with such a climate and such pasturing.

The show of stock opened on the society's grounds on a somewhat clouded morning, which, however, developed into a pleasant day.

Of neat stock, the show was as I expected, and as it should be there, largely composed of dairy stock, and very good it was, though much of it in very thin condition, owing

to the extreme drought which had lasted nearly two months and had dried the pastures and the springs.

The animals were mostly of the Ayrshire blood, with some Jerseys, and grades of both. The Ayrshire stock was introduced here some thirty years ago, and the Jerseys somewhat later, and both are undoubtedly better adapted for use here than animals of other and larger breeds.

There were about a half dozen bulls, some of them grades, entered, I suppose, merely for exhibition, as they could take no premiums by the rule of this Board.

About a dozen yokes of working oxen and steers were shown, some thoroughly "native," if any such thing be.

There were probably from one hundred and fifty to one hundred and seventy-five head of neat stock on the grounds, — only about one-quarter of all that are on the island, showing a great indifference on the part of most of the farmers, who would not take the time and trouble to drive thin stock only five or six miles at furthest to help the show and the credit of the county.

The Messrs. D. W. & R. E. Burgess seemed the most enterprising farmers there. They entered good stock in every department, and showed fine exhibits from a well-managed and productive farm.

Of swine there were but two entries; but as there are on the island only about two hundred hogs and pigs, I didn't expect much.

Of sheep there were but five entries; they were very good. A large proportion of those exhibited were Cotswold grades, but I think the majority of the 1,550 sheep on the island are white-faced, called "Native" sheep, with some Merino blood, and largely descended from the white-faced sheep brought by the colonists from the Texel in Holland, which in 1653 Capt. Humphrey Atherton was allowed to pasture on the Island of Nantucket, subject to the rules of the colony regulating the keeping of sheep. There is also now a large intermixture of the Southdown blood.

It is strange to an outsider that a branch of farm industry so pleasant and profitable, and so eminently suited to be a leading industry, should be so neglected; and also that so little interest should be taken by the farmers of Nantucket

to exhibit to each other, and to visitors from the outside world, a show of what they have. Here are over one hundred farms, and, by the census, ninety-three farmers and twenty-two farm laborers, and yet all the entries, of all kinds of farm stock, were made by thirty-five exhibitors. And this, too, where every farmer could bring his stock with a travel of not over six miles. Indolence, indifference, or a miserable jealousy must be at the bottom of this inaction.

A ploughing match between two horse teams and three cattle teams was well contested, although the land was light, with hardly any sod; the long-continued dry weather had so compacted the soil as to make it difficult to plough, and when done, it lacked the swelling curves of a well-turned sod. This, with some trials of draught teams, closed the exercises of the first day.

The display at the hall was in some respects unusually fine; the potatoes were never surpassed, and they and the very fine roots and vegetables of various kinds attest what might be done here with skill, labor and patience. There was a good show of fruit and flowers for the season, and the customary display of bread, remarkably good butter, needle-work, fancy articles, fine arts and other curiosities. Nor was there wanting, "to fill the bill," the inevitable patch-work quilt, containing over three thousand pieces, more or less, made by an old lady eighty-two years of age.

The second day was devoted to a horse show. Several mares and colts were exhibited, one or two stallions and driving horses. There were trials of draught horses, walking horses and trotting horses, the last very unsatisfactory on account of the clouds of dust, which at times shut out from view the contending steeds.

The second day was made glorious to the people of the island by the visit, for two or three hours, of the President of the United States, who, cruising in the vicinity, gratified the islanders by landing and walking their streets, thereby furnishing conversational material to last them two or three generations.

The cattle show was a very successful one for them, and very creditable for those farmers who took an interest in contributing their stock and productions.

The people of Nantucket must, to a large degree, look to agriculture to help them out of their depressed condition. The records of the past, in numerous volumes of the report of the Secretary of this Board, prove that there is great capacity for production in their soil,—light, but warm, quick and responsive,—and they show results from it in various crops of a hundred dollars an acre. They have a limitless supply of a valuable fertilizer in the kelp and seaweed cast up by the ocean, which costs them only the hauling.

The analysis of seaweeds shows a great amount of most valuable fertilizing material, amounting in the ash to more than seventeen per cent. of potash, twelve of sodium, sixteen of salt, seven of lime, seven of phosphate of lime and twenty-four of sulphuric acid. It will be seen how rich the seaweeds are in the mineral constituents so necessary to plant-life, though not specially so in phosphoric acid. And with such means of compelling fertility at their hands, they should surpass any part of this Commonwealth in the earliness and excellence of their vegetables and the cheapness with which they could run them into market. And this applies with certainly equal force to their farm crops of hay, corn, grains and roots.

The climate is unequalled in New England for mildness, the records of the meteorological observers of the government for years showing from 220 to 237 days in the year without frost, while the larger part of the State gets but from 150 to 160 days at the best; and the lowest reaching of the thermometer is for only a day or two in the year, at 6° below zero, when in other towns it indicated from 14° to 24° below zero. The mean temperature, also, for the year is higher by from two to five degrees than in any town in New England, being nearly 50°.

For a market, beside the consumption on the island of a large proportion of what they could produce, they are but four or five hours from Boston, and arrangements could of course be made for a cheap and quick transportation of their summer crops.

There are some summer vegetables which it would seem might be most fitly raised here, to be placed in the Boston markets soon after the Norfolk and Long Island productions,

such as asparagus, a most popular vegetable and easily grown and marketed, — of which in the State were grown $55,000 worth, most of which went to Boston. Nantucket raised none for sale. Of tomatoes she sold $55 worth, while the amount sold in the State was $138,000, a desirable vegetable, and as readily marketed as it is easily grown. Celery, $50,000 worth in the State; none raised for sale on the island. Cabbages in the State, $440,691; she grew $600 worth. Of strawberries Nantucket raised $59 worth out of the $215,000 worth sold in the State.

Why should she not, beside these, throw into the Boston market early pease, cucumbers, lettuce, rhubarb, melons and squashes without limit?

In 1860 Mr. Allen Smith raised 46 bushels of barley, 26½ bushels of wheat, and 187 bushels of ears of corn, each on one acre; the corn and stover amounting to $125.

E. W. Gardner, 80 bushels shelled corn and 2½ tons of stalks.

In 1864, E. W. Gardner grew 3 acres of corn, yielding a net profit over expenses of $287. D. Folger raised $120 worth of beets, at a cost of only $30 per acre.

James Thompson showed, by carefully kept accounts, that on his farm of 26 acres he had made a net profit of $734, besides including in his labor account a great deal of work in fencing, draining and other work for general improvement.

When we see what have been the bountiful products of the island, we feel confident that what has been done can be again done, and also very much extended.

Less than twenty years ago the beef, pork, mutton and veal produced on the island were in value over $32,000. Ten years after that, they only amounted to $2,200.

Now, with the same soil beneath their feet, the same heavens over their heads, and with vastly improved mechanical appliances to aid them, why should they not, with energy, skill and industry, make as good a showing in the State census of 1883, as they did in 1865?

Beside the printed reports in years gone by, of the farms of the Messrs. Folger, Gardner, Thompson and others, I find one in the reports of our Secretary for 1866, of the

splendid farm of Mr. F. C. Sanford, on the eastern side of the island; who, by the application of 650 loads of kelp, ploughed under deep, on twelve acres of sod land, harvested 600 bushels prime corn, 1,200 bushels of turnips, 500 bushels of carrots, 300 bushels of beets, and 50 loads of pumpkins, the whole aggregating in value over $1,200. He cut hay enough for 35 head of cattle, and made over 2,000 pounds of butter, sold at 50 cents per pound.

In glancing over the census returns of Nantucket for many past years, some curious and interesting facts are noticed.

In 1790 the population was 4,510; in 1820 it was 7,266, of which 64 are given as able-bodied persons engaged in agriculture, 809 in commerce, and 399 in manufactures. There was a steady increase in the population every decade to 1840, when they numbered 9,012, of whom 118 are reported as engaged in agriculture; 579 were colored (more than in any town in the State but New Bedford), and only one idiot on the island.

From about the middle of that decade, which was the heyday of the islanders' prosperity, they began to decline in numbers, wealth and prosperity, till in 1875 they numbered but 3,201, with 62 colored and 3 idiots, which latter class seems to have increased in a geometrical ratio.

In 1840 they had five academies and grammar schools, with 630 pupils, and twenty-eight public schools, with an attendance of 1,150; now, five schools, with 447 scholars.

In 1810 Nantucket had no woolen, no cotton, no fulling mill, nor carding machines, but there were woven in hand-looms 4,300 yards of woolen cloth for wear, worth $7,000; and there were knit 4,000 pairs of woolen stockings, worth $4,000; and there were made 1,000 hats, valued at $2,000; there were no foundries, nor rolling mills, nor manufactories of gold and silver work, but they made 80,000 pounds of soap, $150,000 worth of spermaceti candles, and $25,000 worth of sperm and whale oil; they made no snuff nor tobacco in any form, and distilled no rum nor cider brandy; but they made 30,000 casks, worth $60,000; and made $13,000 worth of rope, and tanned 2,800 hides, and made 2,500 pairs of boots, worth $8,000; and, best of all, they had 10,000 sheep ranging the whole extent of the island.

In 1837 they had 7,000 sheep, yielding $7,500 worth of wool; they had 31 forges; they employed 74 vessels in the whale fishery, with 1,897 men engaged; of sperm and whale oil they imported to the amount of $1,114,012, and manufactured $515,663 worth of sperm candles, and $1;873,199 of whale and sperm oil, — all together employing over $5,000,000 of capital, — and they made 6,500 oil casks, employing 67 men.

In 1840 they raised 591 bushels of corn, 4,525 bushels of potatoes, 867 tons of hay, and dairy products to the amount of $11,065, besides growing and reeling 1,000 pounds of raw silk, worth $9,000.

In 1845 they had 77 vessels engaged in the whale fishery, which brought in oil to the value of $915,000, and $10,000 worth of whalebone. The value of the manufactured oil was $1,279,817; of candles, $214,645; and of soap, $7,800; they made 300,000 pounds of cordage and $40,000 worth of casks; they had 7,500 sheep and $4,000 worth of wool; they had of horses 442; of neat cattle of all kinds, 1,053, and 1,300 hogs; of corn they raised 500 bushels; of potatoes, 6,000 bushels; beets and vegetables, $1,400 worth; of hay, $42,000 worth; and they made 30,000 pounds of butter, sold at twenty-five cents per pound; while at the same time, in the four western counties of the State, ten cents was the going price, and a ninepence per pound the top of the market.

In 1855 the people of Nantucket had but 44 vessels employed in the whale fishery; imported but $397,563 worth of oil; made of manufactured oil only to the amount of $768,529; $17,000 worth of sperm candles, and $2,170 of soap.

Their sheep numbered but 1,200, producing less than $1,200 worth of wool; horses, 346; oxen and steers, 112; cows, 548; heifers, 205; of corn they grew 7,980 bushels; of potatoes, 7,776 bushels; of turnips, carrots, onions, beets and other vegetables, $14,886. Their hay amounted to $42,581. Of butter they made 24,152 pounds, valued at $7,155.60, or within a fraction of 30 cents per pound, while in all the western counties it was sold at 18 and 20 cents.

In 1865 they had but $5,590 worth of oil, imported by only seven ships; employed two men in the manufacture of 87 casks, and turned out sperm candles to the value of $800, and soap to the amount of $2,000. Of sheep they had 2,153, giving 3,623 pounds of wool; horses, 251; cows and heifers, 571; and 13 bulls, and 60 oxen and steers. Of corn they grew 7,575 bushels; of potatoes, 4,807 bushels; turnips, carrots, beets and other roots, $3,228 worth, and $26,000 worth of hay. They also sold 10,831 gallons of milk for $2,599.44, or at the rate of twenty-four cents per gallon, and they sold 14,436 pounds of butter for $6,137.48, or at the rate of forty-two cents per pound, while the other parts of the State sold for thirty-five cents, with an occasional forty cents per pound.

In 1875 the ships of Nantucket had sailed, never to return; the oil had run away, and the candle manufacture was snuffed out, leaving all that splendid business drawn from the ocean depths in outer utter darkness; henceforth from the bowels of the earth, and not from the head of the sperm whale, are the dark places of the earth to be illumed.

In that year their sheep were 1,300, yielding 3,533 pounds of wool; their horses and colts numbered 141; their milch cows 376, from which they made of butter 22,865 pounds for sale; and 4,120 pounds for home consumption, being only between 71 and 72 pounds to the cow — and the cows averaging each only 400 quarts of milk. This gives to each inhabitant only a little over eight pounds for the year. So that they must also have largely imported from the main land beside, if, as butter-eaters, they equal their brethren in Franklin County, who consume in their families from 12 to 20 pounds annually for each individual. Of corn they raised 5,759 bushels; of potatoes, 7,223 bushels; of oats, 1,500 bushels; of turnips, beets and other vegetables, $9,200 worth, and cut $35,000 worth of hay.

I know of nothing in the history of our State which compels so sad feelings as the decadence in less than a half century of this most prosperous flourishing city and island, once teeming with business activity, the home of brave men and fair women, the abode of a profuse, unstinted hospitality; its trade and commerce gone, and so fallen from its high

estate, that even many of its very buildings have been taken down and carried to other parts of the country, to shelter heads less worthy than those who planned and built them.

In comparing its present struggling condition with the glories which encircled it forty years ago, one may well say, "How art thou destroyed that wast inhabited of sea-faring men, the renowned city which wast strong in the sea, — she and her inhabitants. When thy wares went forth out of the seas thou filledst many people; thou didst enrich the kings of the earth with the multitude of thy riches and thy merchandise."

But while the industries and manufactures drawn from the sea have forever gone, they are being supplemented to some extent by the more common and equally useful ones that supply the wrought material, and call for that labor which makes prosperous many an inland town; and as the charms of this island become more and more appreciated by dwellers of the hill country and of the West as a delightful summer resort, the thousands of visitors must be fed; and the harpoon being beaten into a ploughshare, and the blubber-spade into a shovel, must become the favorite implements of the islanders, whose agricultural energies will be largely taxed to supply the daily necessary wants of these welcome summer guests, many of whom will in time, under the attractions of scenery and climate and the cordiality of the people, become pleasant residents.

It is to be hoped that Nantucket has seen its darkest days, and that in its agriculture at least there may be a revival, which I believe is sure to come if the people will exercise in their farming a little of the energy, pluck and business management so long, so ably and so successfully displayed in their maritime operations.

Since the last State census, the farmers there have increased their horses, within six years, from 122 to 300; their cows from 376 to 515; their sheep from 1,298 to 1,552.

If increased taxation be an evidence of increased prosperity, they should be happy in knowing that they have 5,000 more acres assessed than in 1875; that the assessment is $9,069 more on their personal, and $179,116 on their real estate than then.

Within ten years the farm acreage has increased over 4,000 acres, the cultivated land over 200 acres, and the total value of farm lands and buildings over $40,000. I believe that the next State census will show a thrifty advance beyond any period within the past twenty-five years, and that in coming years the people of Nantucket shall not rest solely on their long-ago acquired reputation as bold and daring sailors and enterprising merchants, but shall also have added the character of skilled and successful farmers.

JAMES S. GRINNELL.

III.

MINERAL CONSTITUENTS IN PLANT GROWTH.

BY

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[Read before the Massachusetts Horticultural Society, March 18, 1882.]

A careful examination of the circumstances which have favored the recent introduction of a more rational farm practice for the production of crops, cannot fail to prove that the recognition of the important influence which certain mineral constituents of plants exert on plant growth in general has contributed more to our success in agriculture than any other one which may be stated. The confidence in the correctness of the current opinion, that the presence of these mineral constituents in an available form in the soil is essential for the reproduction of any plant from its seed, is so firmly established in the minds of thinking agriculturists that we are apt to forget how recent the date when the first comprehensive experimental investigations in that direction rendered the existence of these relations between soil and plant more conspicuous. It seems at the present time almost incredible to notice in the writings of Justus von Liebig that, as late as 1830, one of the leading botanists of the University of Berlin, Sprengel, still asserted that ground bones are of no use as a fertilizer in Germany; or that the distinguished French chemist, Dumas, even ten years later, considered the mineral constituents of plants a mere incidental feature in the vegetable economy; or that before 1840, not one pound of Peruvian guano was used upon the farms of Europe, although Alexander von Humboldt, in 1814, had described its use as a fertilizer in Peru,

and some ship-loads of that material had found their way to the London market. In citing these instances, I need not state that neither Liebig nor any other well informed student of the agricultural practice in previous ages denied the high appreciation of wood ashes, bones, gypsum, lime, marl, and other mineral substances, besides the various kinds of animal manures, in the farm management of earlier times. Modern rational agriculture does not rest its claim of progress on the mere introduction of any particular new mode of operation. For to try to maintain a remunerative fertility of the soil under cultivation by fallow and the rotation of crops, or to enrich one portion of the farm lands at the expense of another one by retaining a certain proportion of meadows and pastures to secure manure for the grain-bearing lands; or to enrich the surface soil at the expense of the subsoil by raising deep-rooting plants, as root crops, or leguminous crops, as clover, etc., for fodder and manure; or to improve the natural productiveness of the lands by deep ploughing, or by drainage, or by irrigation, are all modes of farm practice known, more or less, for hundreds of years. Our real progress in this direction consists mainly in the discovery of the *principles* which control the successful application of these practices in the management of farms.

Rational modern agriculture recognizes as the foundation of a successful farming, the necessity of a strict restitution to the soil, in an available form, of those substances which the crops have abstracted, and it promises to that class of farmers who strive to comply with that requirement in the most economical way, the best chances of a *continued* financial success.

From a similar standpoint the earlier practice of using the above-named mineral substances and others in the farm management has to be judged as compared with their application at the present time.

As long as the composition of the air and the water was but little understood, and that of the soil practically unknown, no correct idea could be formed concerning their mutual relations, and still less regarding their connection with the life and the growth of plants.

For this reason, the first *successful* attempts to study the relations of the vegetable kingdom to these three agencies date only back to the close of the past century. They are largely the results of the labors of Lavosier and Priestley. Foremost among the scientists who, at the beginning of the present century, devoted some attention to the chemical physiology of plants and the application of chemistry to agriculture, are De Saussure and Sir Humphry Davy. The former was the first who called attention to the variations of mineral constituents in plants, and pointed out some of their relations to the soil and growth of plants, whilst the latter recognized already the atmospheric source of nitrogen for plant growth. The works of these illustrious investigators remained comparatively unknown to agriculturists until Liebig, in his celebrated work, "Die Grund-sätze der Landwirthschaft," in 1840, called the general attention to their excellence and importance. Although more exact analyses of the ashes of plants had been accumulating, and some interesting features of the results had been pointed out,—as for instance the limited number and constant occurrence of the same mineral elements, as well as their varying proportions in the case of different plants,—no material change of opinion regarding their possible more intrinsic relations to plant life took place during the time which passed between the first publication of the investigations of De Saussure and Davy, and those of Liebig. The year 1840 is, on this account, usually cited as the beginning of a new era in the history of agriculture and its associated branches. It is justly claimed as one of the most valuable services which Liebig has rendered to scientific and practical agriculture, that he demonstrated by the aid of previous investigations, as well as his own, the true connection which exists between soil and plant, and the *intrinsic* value of the mineral constituents in the growth of plants.

Accepting, as we do, Liebig's teachings that a certain kind and certain amount of mineral elements are indispensable for the complete development of a plant through all its various stages of life, and that, in case the ash constituents of the lant are not supplied in due time, the plant may come top blooming, yet cannot produce a perfect seed, it becomes

quite obvious that the time-honored practice of using wood ashes, or lime, or marl, etc., above referred to, for manurial purposes, presents quite a different aspect to us from any that it could possibly claim in previous ages; for knowing now, in consequence of previous careful analysis of the ashes of its particular kind, what elements the perfect plant contains, the practical experience of the past receives a more intelligent interpretation of its results, and future success a better chance.

The direction which Liebig's genius has given to the study of plant growth, with reference to its application in practical agriculture, has been pursued since with an interest and success unparalleled in the history of any province of science. Practice and science have already for years worked hand in hand to study the influence of physical and chemical agencies on the production of vegetable growth, and to reconcile real and apparent differences of experimental results.

Much has been accomplished — too much, in fact, to find here a mere passing enumeration; yet much more remains to be learned to free our present system of manuring from that degree of uncertainty which a reasonable prospect of success still demands. The unsatisfactory condition of our current modes of fertilizing our lands is, in a great measure, due either to limited information or almost entire ignorance concerning the following points: —

1. What are the mutual physical and chemical reactions of the various kinds of soil on the *different* materials we apply for fertilizing purposes? In other words, what becomes of the fertilizer in the soil?

2. In what *particular* form do the different plants absorb the various kinds of mineral plant food?

3. What are the *specific* functions of the different mineral substances of the plant food in the life of plants? What effect do they produce when applied in *different* combination?

The history of all well-conducted field experiments points upon every page to the necessity of a closer study of every one of the above specified points, before any material improvement in our present mode of fertilizing our lands

can be expected. The recently introduced practice of supplying our markets with special fertilizers for particular crops, if carried on beyond a limited generalization, deserves attention on account of the purpose of dealers to meet the desire of the farmers, rather than on account of either good economy or of a superior information in regard to the *special* wants of the *particular* kind of crop raised *under all conditions*. This remark applies with particular force to their use in horticulture and fruit culture; for the composition of most garden crops, as well as of fruits, is far less known than that of the majority of our farm crops.

A few ash analyses of plants do not suffice to decide what *kind* and what *amount* of mineral plant food a crop *needs*, and still less in what combination they produce the best effect. They simply tell what kinds and amount the plants under examination *contain*. It is a well-established fact that the same variety of plants, when raised upon different kinds of soil, or upon the same soil of a varying degree of richness, may contain a widely differing absolute amount of the same mineral constituents. There is, apparently, in plant life, a possibility of an excessive consumption of food, as we know there is in the case of animal life. Science has not been able, thus far, to ascertain the existence of any *definite numerical relation between the exact amount of essential mineral elements of plant food* and *the amount of organic matter which may be produced by the aid of the former*. Whilst we are thus still ignorant in regard to some vital points in plant life, it is quite encouraging to notice the steady progress in studying the more intrinsic relations which evidently exist between the composition of the organic and inorganic portion of the plant. The very circumstance that the various mineral elements cannot substitute each other to any extent, if at all, without altering the relative proportion of the proximate organic constituents of the plant, or even endangering its very existence, suggests that dependency. The question, Can we alter the composition of plants, and if so, in what direction, and by what means? has become of late one of the most prominent subjects of agricultural investigation. The best scientific resources of our time are called on to ascertain the prin-

ciples which underlie a successful practice, if for no other reason than the prospective large pecuniary interests involved. Agriculture has already realized considerable advantages from investigations in that direction, by learning how to cultivate certain plants, with either a view to increase their value for fodder, or to enhance their market price for some industrial application. Numerous experiment stations do at present attend to the wants of agriculture; and horticulture, the most successful branch of agriculture, begins to realize the advantages it may secure by adopting the same course. Experiment stations for the promotion of its special interest date from 1870, Germany claiming already three or four, to experiment solely with fruits.

My peculiar situation, as far as time and means were concerned, as well as a personal interest in the progressive work of the present, induced me some years ago to undertake, with the kind assistance of Professor S. T. Maynard, of the State Agricultural College at Amherst, a series of experiments upon the college grounds for the purpose of testing the action of more or less compound chemical manures, and of simple chemicals, on the production and composition of some fruits. Some of my results obtained in that direction are already, in part at least, published; others, of a more recent date, are only known to those connected with the work. I propose to relate both here, as far as they may add some interest to the matter under discussion.

I.—Experiments with Grape-vines.

Action of a special chemical fertilizer on the composition of the organic and inorganic portion of the Concord Grape and the Native Blue Grape (Vitis Labrusca).

The Concord grape-vines which served in the experiments were planted in 1869, upon former pasture land. No fertilizer had been applied in the new vineyard excepting wood ashes but once in 1871, previous to my investigation.

In 1873 several plats containing three rows of Concord vines, six in each row, were set apart in a suitable locality for the application of the special fertilizer. Directly adjoining were planted at a similar distance from the Concord vines, corresponding every way with the arrangement of the former, in each plat twelve wild-growing specimens of the *Vitis Labrusca* (wild blue grape), taking care at that time that a part of the wild grape-vine remained in its original place to secure the identity of variety, etc.

The original plant was left to its natural resources, and the transplanted part treated, in common with the Concord vines, with the following fertilizers per acre: — four hundred and fifty pounds of dissolved bone-black, containing twelve per cent. of soluble phosphoric acid, and one hundred and eighty pounds of nitrate of potash, containing forty-five per cent. of potassium oxide and thirteen per cent. of nitrogen; or fifty-two pounds of soluble phosphoric acid, eighty-one pounds of potassium oxide, and twenty-three pounds of nitrogen. One half of the fertilizer was applied in the fall, the other half early in the spring.

The examination of the grapes from fertilized and unfertilized localities began three years after the first treatment of the various plats, and only the fruits of a corresponding state of ripeness served for the tests. The berries, freed from the stems, furnished the ash constituents. The juice of the entire grape was tested for grape-sugar only.

The result of all ash analyses contained in these pages, including grape, strawberry, and peach, are reported here only with reference to five prominent constituents: Potassa, lime, magnesia, iron, and phosphoric acid. Other constituents of the ashes, as soda, silica, etc., although quantitatively determined, are for the present excluded from the discussion. The various subsequent analytical statements do, therefore, not represent the composition of the entire ash, but refer to the relative proportions in one-hundred-weight parts of the specified constituents. This course has been adopted to render the changes which occur in that direction more prominent.

	Unfertilized Wild Purple Grape, from the original locality (1876). Ash constituents.	Unfertilized Concord Grape from the College Vineyard (1876). Ash constituents.
Potassium oxide,	52.54 per ct.	67.70 per ct.
Calcium oxide,	22.93 "	13.39 "
Magnesium oxide,	5.77 "	3.67 "
Ferric oxide,	0.81 "	0.47 "
Phosphoric acid,	17.95 "	14.77 "
	100.00	100.00
	Sugar in juice (1877). 8.22 per ct.	Sugar in juice (1877). 13.89 per ct.

	Fertilized Wild Purple Grape, from College Vineyard. (1876). Ash constituents.	Fertilized Concord Grape from experimental plat. (1876). Ash constituents.
Potassium oxide,	66.35 per ct.	69.68 per ct.
Calcium oxide,	15.08 "	9.84 "
Magnesium oxide,	4.15 "	3.91 "
Ferric oxide,	0.57 "	0.54 "
Phosphoric acid,	13.85 "	16.03 "
	100.00	100.00
	Sugar in juice (1877). 13.67 per ct.	Sugar in juice (1877). 15.43 per ct.

The fertilized vines appeared, on the whole, more vigorous, and the leaves, as a rule, retained their vitality longer in autumn than in the case of the unfertilized ones; they escaped repeatedly a serious attack of mildew when the remainder of the vineyard suffered with it more or less. The sugar seemed to be somewhat increased in the fertilized fruit of the Concord grape, and had increased one-third in quantity in the wild purple grape. The increase of sugar was accompanied by a marked increase in potassa, and, at the same time, a remarkably reduced percentage of lime in the inorganic portion of the grape. The influence of fertilization on the composition and the character of the fruit manifested itself in a higher degree in the case of the native wild grape than in the case of the improved variety. The results of these experiments afford an additional illustration of the opinion that special fertilization must be considered a factor of more than ordinary importance in fruit culture. Of course, sugar alone does not control the quality, yet the fact

that its amount can be altered by fertilization shows the existence of still untried modes of treatment to promote the interests of horticulture; for what has been noticed to affect the quantity of sugar may, by some modification, prove efficient in regard to other constituents.

The entire vineyard has been for several years fertilized, with satisfactory results, with fifty pounds of soluble phosphoric acid, one hundred pounds of potassium oxide in form of muriate of potash, twenty-five pounds of nitrogen in form of Chili saltpetre (sodium nitrate), and twenty pounds of magnesium oxide in form of crude sulphate of magnesia, or kieserite.

II.—Experiments with Strawberries.

The varieties used for the experiment were the President Wilder and Charles Downing. In the case of the Wilder strawberry the following fertilizer was used per acre: Three hundred pounds of rectified Peruvian guano, two hundred and fifty pounds of dissolved bone-black, and two hundred pounds of muriate of potash. The following analyses convey a good idea of the difference in ash constituents between the common wild variety, without special manures, and the cultivated variety. The Wilder was raised with the aid of the above-mentioned fertilizers:—

	Wild Strawberry (Richardson). Ashes of fruit.	Fertilized Wilder Strawberry (College grounds). Ashes of fruit.
Potassium oxide,	38.38 per ct.	54.07 per ct.
Calcium oxide,	25.89 "	14.79 "
Magnesium oxide,	trace	8.92 "
Ferric oxide,	10.56 "	1.91 "
Phosphoric acid,	20.30 "	20.31 "

The common wild strawberry contains usually one part acid to two of sugar, whilst it changes in the cultivated varieties from one of acid to four and more of sugar.

The experiments with the Downing variety were carried out for the purpose of studying the effect of five different kinds of special chemical manures on the ash constituents of this variety of strawberry. Five plats, fourteen hundred and thirty square feet in size, received the following fertilizers:—

Plat One.—Fifteen pounds of superphosphate (12 per cent. soluble phosphoric acid) and 5 pounds of nitrate of potassa.

Plat Two.—Five pounds of nitrate of potash and 10 pounds of calcined kieserite (crude sulphate of magnesia).

Plat Three.—Fifteen pounds of superphosphate of lime, 5 pounds of nitrate of potash, and 10 pounds of kieserite.

Plat Four.—Received nothing.

Plat Five.—Fifteen pounds of superphosphate of lime, 5 pounds soda saltpetre (Chili saltpetre), and 5 pounds of muriate of potash.

The fertilizers were partly applied in the fall, partly in the early portion of the spring; the fruits were collected in the second year, after applying the first fertilizer.

Analysis of the ashes of the Downing Strawberry raised upon the above stated five plats.

	I.	II.	III.	IV.	V.
Potassium oxide, ...	62.13	56.72	61.81	58.47	62.29
Calcium oxide, ...	12.57	14.12	12.21	14.64	12.46
Magnesium oxide, . . .	5.96	3.29	6.00	6.12	6.33
Ferric oxide, ...	2.32	3.77	3.64	3.37	2.50
Phosphoric acid, ...	17.02	20.10	16.34	17.40	16.42
	100.00	100.00	100.00	100.00	100.00

The changes in the organic portions of the fruit raised upon the various plats will be studied the coming season, if time permits. As the mineral constituents of the berries show similar changes in relative proportion to those noticed in the previous experiments with grape-vines, it is to be assumed that similar changes in the organic matter, and thus in the quality of the fruit, will be found.

The lime has decreased, and the potassa has increased, in plats one, three, and five, as compared with that in plat four.

The unfertilized plants in plat two form apparently an exception; yet the result may find a satisfactory explanation by the well-known peculiar action of the sulphate of magnesia in sending the potassa rapidly to the subsoil, and thus beyond the reach of the roots of those plants which feed on

the surface soil. Accepting this explanation, we have to assume that the presence of the superphosphate of lime (see No. 3) counteracts that tendency of the kieserite.

III.—Experiments with Peach Trees.

The trees were planted by Professor S. T. Maynard, at different times, beginning with 1869. Those under special treatment for the disease called the "yellows," were planted in 1870. Of this planting, those on the top of the knoll, in light soil, have shown the greatest indication of the disease, whilst those within seventy-five yards, in lower and richer lands, appear to-day perfectly healthy. For five years after planting the trees received but little care, and little if any manuring except that applied to grow one or two crops of corn upon the land used. No special manures were applied until 1876; and since that time only one crop (squashes) has been taken from the land, except the fruit from the trees. The land has been kept light and mellow by means of a large cultivator, and by light ploughing once or twice.

Two rows of the trees received in 1876 a dressing with two different chemical fertilizers. The trees had been planted twelve feet apart in every direction. The fertilizers were applied in a radius of eight feet around the tree, taking care to keep off about one foot from their trunks.

Fertilizer No. 1 consisted of thirty pounds of rectified Peruvian guano, twenty-five pounds of dissolved bone-black, thirty pounds of sulphate of potassa (Stassfurt salt, containing from twenty-five to twenty-eight per cent. of potassium oxide), and twenty pounds of crude sulphate of magnesia, or kieserite.

Fertilizer No. 2 consisted of thirty pounds of rectified Peruvian guano, twenty-five pounds of dissolved bone-black, and twenty pounds of muriate of potash. The amount specified in both instances applies to one-tenth of one acre. The trees which received either one of these fertilizers have made a better growth, and produced more and better fruit since, than the trees adjoining. There is no apparent difference between the trees upon the two experimental plats.

In the case of pear trees in different plats, which were treated in the same way and at the same time with both fertilizers, Fertilizer No. 1 has produced the best results in growth and in fruit. Both, however, surpass the unfertilized trees.

In 1880 a new series of experiments was inaugurated with iron sweepings and iron-containing phosphates. The entire orchard has received since, annually, some potash-containing phosphates, with good results. The special treatment of the diseased peach trees, pronounced by good authority to be suffering from the yellows, began in 1878, when my personal attention was first called to its appearance on the top of the knoll in the college orchard. Instead of undertaking to describe here the characteristics of that much-dreaded disease of the peach tree, I prefer to leave that task to my friend, Professor D. P. Penhallow, a graduate of the Massachusetts Agricultural College in 1873, who has kindly assisted us during the past eight months by carrying on such microscopic observations, regarding the origin and the nature of the disease through some of its various stages, as seemed desirable to me for the formation of an intelligent opinion concerning the possible cause of the disease. The results of Professor Penhallow's work are of unusual interest, and I do not doubt will be deservedly appreciated by all those who take an interest in the subject here under discussion. The manuscript containing a detailed description of the characteristics of the disease, and his microscopic work, illustrated by drawings representing various stages of the disease, will form a most valuable addition to the present discourse. The manuscript is at the service of the society; and the Professor, who, at my solicitation, is present, will be pleased to explain his observations if desired to do so.

The general appearance of the diseased trees suggested to my mind, at first, that an abnormal condition of the soil might be the cause. This condition might be ascribed either to a more or less general exhaustion, or to an absence of only some one or other *essential* element of plant food; or, finally, to the presence of some injurious substances which might have accumulated in the soil from some cause or other in the course of time. I felt inclined to consider,

in either of these cases, the fungus which covers and disfigures the diseased parts of the trees a secondary feature of the disease. My observations of later years, with grapevines and currants in particular, have tended to strengthen in my mind that view in regard to many of our troubles with parasitic growth and diseases of plants. I have repeatedly noticed that plants suffered seriously from mildew and blight upon unfertilized and exhausted lands, when upon adjoining fertilized plats no sign could be noticed. On the other hand, the healthy condition of the roots, even to the last stage of the disease, and also the gradual disappearance of the green color, indicating insufficient production of chlorophyll, which causes the gradual change from a healthy appearance to a sickly one, beginning with the outer termination of the branches, which is the most active part for the formation of new vegetable matter, seemed to point towards a localized trouble, — a possible interference with the normal cellular functions, — an alteration of the osmotic action of the cellular tissue, and thus subsequent death of its affected part. This view of the case found support in the well-known observations of Messrs. Nobbe, Schrœder, and Erdmann (Chemnitz, 1871), regarding the action of sulphate of potassa and chloride of potassium on the growing of rye and of buckwheat. Sulphate of potassa had caused first a premature yellow color of the entire plant, which terminated with its gradual failing; whilst the chloride of potassium (muriate of potash) had caused a vigorous growth, a rich, dark-green colored foliage, and a successful production of grains.

An examination of the cellular tissue of the diseased plants had shown an excessive accumulation of starch in the cellular tissue, indicating thereby a retention of that constituent, and but little chlorophyll was noticed. On the strength of these results I began, in 1878, to treat slightly affected trees with a phosphatic fertilizer in the usual proportion, adding at the same time from three to four pounds of chloride of potassium (muriate of potash) for every tree, and the diseased branches were cut back once or twice to the healthy wood. Soon after, the new growth of the branches regained its green color. The details of this work were

carried out by Professor Maynard, who to-day reports these trees in a vigorous condition. Not feeling satisfied with a mere assumption based on a presumed analogy of circumstances, during the last summer I invited Professor Penhallow to study the condition of the cellular tissue in branches collected on the 11th of November, 1881, from trees thoroughly diseased, and also from trees which were once diseased and are to-day in good healthy condition. For myself I reserved the analysis of the mineral constituents of a lot of branches from the same trees, collected the same day. In connection with these analyses I also made the analyses of the mineral constituents of the ripe and healthy (entire) early Crawford Peach, and that of the entire, prematurely ripened, diseased fruit. The following statement contains my results: —

	Fruit. Crawford's Early Peach. Healthy.	Fruit. Crawford's Early Peach. Diseased.
Ferric oxide. Fe^2O^3,	.58 per cent.	.46 per cent.
Calcium oxide, Ca O,	2.64 "	4.68 "
Magnesium oxide, Mg O,	6.29 "	5.49 "
Phosphoric acid, P^2O^5,	16.02 "	18.07 "
Potassium oxide, K^2O,	74.46 "	71.30 "
	100.00 "	100.00 "

	Branch. Crawford's Early Peach. Restored.	Branch. Crawford's Early Peach. Diseased.
Ferric oxide,	.52 per cent.	1.45 per cent.
Calcium oxide,	54.52 "	64.23 "
Magnesium oxide,	7.58 "	10.28 "
Phosphoric acid,	11.37 "	8.37 "
Potassium oxide,	26.01 "	15.67 "
	100.00 "	100.00 "

The above analytical results show a remarkable difference in the composition of the mineral constituents of the healthy and the diseased plant. The differences in both cases are most remarkable as far as potash and lime are concerned. The difference is more conspicuous in the branches than in the fruit. The diseased objects contain less potash and more lime than the healthy ones.

The subsequent statement contains a summary of Professor Penhallow's results: —

1. Healthy wood shows comparatively little stored starch; but fungous growth is present in the outer layers of the bark.

2. Diseased wood shows an abnormally small development of the cells, and the invariable presence of large quantities of starch; also an abundance of fungous growth.

3. Diseased leaves show the presence of fungous growth, discoloration, and cells filled with starch.

4. The fungus appears first on the surface of the trunk or branches, and thence enters the woody structure when the conditions are favorable.

5. There is little or no difference between the tissues and cell contents before and after the leaves fall.

6. While fungus is abundant on fully diseased trees, it is also to be found on trees which, *once diseased, had been restored to a condition of vigorous health.*

The previous statements seem to confirm some of the views entertained by me when planning the investigation. The results seem to point towards an interior disorder before the fungus enters the living tissue.

Whether some other internal or external influence, or both, inaugurates the disease, whether the various forms of the disease are merely a matter of degree, or whether they are of an entirely different character, must, of course, be left to future investigation. I consider my results of a general interest rather on account of what they suggest than of what they seem to prove.

IV.

TWENTIETH ANNUAL REPORT OF THE MASS. AGRICULTURAL COLLEGE.

To His Excellency the Governor and the Honorable Council:

Since the last report was made, important changes have occurred among the officers of government and instruction in the college. Edward C. Choate of Southborough has been elected trustee in place of William Wheeler, resigned. Both of these gentlemen are graduates of the college. The resignation of the Hon. Levi Stockbridge, as president, has removed from the college one who has been identified with it from the beginning, and who, by his long and successful labors here, has won for himself a high position among the agriculturists and educators of the country. His place was filled by the election of P. A. Chadbourne, late president of Williams College and formerly president of this institution. Mr. A. B. Bassett has been elected to the chair of mathematics and physics, and is performing his work with marked skill and success. The chair of agriculture, left vacant by the resignation of President Stockbridge, has been temporarily filled in a very acceptable manner by Mr. John W. Clark. Dr. Manly Miles, formerly of the Michigan Agricultural College, has been elected to this chair and commences his instruction the present term. Mr. Clark will continue as associate instructor in agriculture, having care of the class work in the field. Robert W. Lyman, Esq., of Belchertown, a graduate of the college, has given instruction in rural law, and Dr. Edward Hitchcock, Jr., in elocution. The president has given instruction in general zoölogy, entomology, and mental philosophy. In the present year he is also to give instruction in geology. He also conducts religious worship on the Sabbath in the college

chapel. The other departments of instruction remain as they were at the time of the last report.

The course of study has been so far modified as to introduce more instruction in the structure of the English language, rhetoric and history. The study of French and German heretofore required has been made optional, and the time of recitations so arranged that each student can study both languages if he so elects.

The work of the college has been most efficiently done. The improvement of the students in their studies and in that good order and gentlemanly deportment so desirable in college, has been highly satisfactory.

While we could use to great advantage much larger means than we have, and should have the assistance of specialists in different departments of science, which our limited means do not warrant us now in securing, we should be false to the best interests of the college, as well as ungrateful towards the nation and Commonwealth, if we did not fairly recognize what they have already done in making this college an efficient agency in the work of practical, liberal education. In seeking for more which is needful, we have perhaps too much lost sight of, or kept from the public view, what we now have.

It is plainly evident that the people of the State, as a whole, have not understood the provisions here made for the education of the young men of Massachusetts. When committees from the legislature and others have visited the institution and become acquainted with its organization, its means of instruction, and its actual work, the college has proved its own best advocate. To make the college and its work better known to all the people of the State, we ask a careful consideration of the course of study and of the reports of various departments. We also feel justified in once more calling the attention of the legislature and the people of the State to the founding and organization of this institution as well as to its present condition.

The grant of land and land-scrip for founding agricultural colleges was made by the general government in 1862. The civil war had brought out with great clearness the elements of national strength, — varied production in agriculture and

the mechanic arts, and a citizen soldiery well trained in the art of war. To secure all these in their greatest perfection, was the aim of the bill for establishing "Industrial Colleges" in the various loyal States. Whatever mistakes may have been made in the organization and management of these institutions, no fault can be charged home to the original bill. It was eminently a wise measure, and suggested an outline of organization and management that has not as yet been improved upon. Its significant words are as follows: "The endowment, support and maintenance of at least one college where the *leading object* shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are *related* to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the *liberal* and *practical* education of the industrial classes in the several pursuits and professions of life." No branch of learning peculiar to the old colleges was to be necessarily excluded; but the new colleges were to push on to the practical application of the sciences they taught, and they were to train all their students as defenders of their country against domestic rebellion or foreign invasion. In a word, they were to educate their students as *men* and as *American citizens*. The rank of the education given is "*liberal*," the term applied to the education given by the highest institutions then known. It was to be so broad as to fit men for the "several pursuits and professions of life." The object of these colleges was to obliterate the supposed superiority of the so-called "learned professions," by securing a "liberal," that is, the highest education, for those who chose industrial pursuits, thus lifting agriculture and the mechanic arts from the plane of mere routine labor to the dignity of learned professions, founded upon scientific knowledge and allied to, or connected with, those branches of learning essential for a broad and generous culture of the whole man. Many who have attempted the management of these colleges, as well as many who have criticised them, have apparently overlooked the broad and generous plan upon which they were founded. It is doubtful if they will ever accomplish the great work for which they were intended, until

their original purpose is so fully and constantly recognized and carried out by judicious, painstaking work, that the currents of education shall be once fairly turned toward these new channels. When once fairly turned, that they will continue to flow can no more be doubted than we can doubt the success of any natural process when not artificially obstructed. An education that "gives boys what they need to daily use when they become men," commends itself as rational and practical. All true education should aim at this. And this certainly is the idea that is embodied in the bill founding the industrial colleges of the several States. The provisions of this bill were accepted by Massachusetts. One-third of the funds received from the United States was given to the Institute of Technology in Boston for the promotion of the mechanic arts, and two-thirds were devoted to founding a college at Amherst for the special work of agriculture. By the gift to the Institute of Technology, the Agricultural College has been freed from much labor in building up a mechanical department, — a fact that has been lost sight of by some, — and is left free to carry out the idea of a college making agriculture the leading idea, while it secures rigid training in military tactics and provides such a range of studies in science, literature and philosophy, as shall, in the words of the bill, promote "*liberal education.*"

The college now has 383½ acres of land for farm, gardens, nurseries, etc. It has college buildings, laboratory, botanic museum, plant-houses, gardens and nurseries, so that provision is made for teaching all the sciences that relate to the cultivation of the soil, and these sciences are practically applied to all the work of the farm, garden, vineyard and orchard. The Durfee plant-house and propagating houses afford practical instruction the year round.

The course of study aims to do what the original bill declared should be done,— give a practical knowledge of agriculture and horticulture, and at the same time so educate the *man*, that the students from the Agricultural College shall not be mere artisans, having learned a trade or business and nothing more, but be liberally educated, so that, as farmers, they shall rank in intellectual training with those who chose what have heretofore been called the "learned

professions." It is plain that farming will never take its true place, nor farmers have that influence in the government of our land which they ought to have, until they take their place with those in other professions, not only as men of power and practical ability, but as men of learning and culture. Those who claim that the farmer's life forbids this result, have never yet fully appreciated the farm as a place for study and thought, as well as a place for labor.

The course of study in the Massachusetts Agricultural College, at the present time, embraces the following topics :—

1. *Lectures on Health and Habits of study*, and general plan of the college work. These lectures are now given by the president. The student, as he begins his college work, is instructed as to the best means of preserving health, the best methods of study and of recitation to secure knowledge, and the best mental training at the same time. He has laid before him the studies of the whole course, so far as he then is able to understand them, that he may in the beginning have some just idea of the value of the different studies, may understand why they come in the order they do, and how they make a complete educational whole to secure the purpose for which the college exists.

2. *Botany* — structural and systematic — special application to cultivated plants — *Microscopy*.

3. *Zoölogy* — systematic, with special studies in *Entomology*.

4. *Agriculture* — extending through the entire course of four years — study of soils — methods of working — fertilizers — draining — farm implements — special crops, etc. *Stock* and *Dairy Farming*, with lectures on *Veterinary Science*. *Work on the Farm* under direction of the Professor of Agriculture, six hours a week, when such work can be supplied.

5. *Horticulture*. Market Gardening—Arboriculture, Care of Nurseries—Landscape Gardening. Work in nurseries, propagating houses and vineyard done under direction of Professor of Horticulture.

6. *Chemistry*. Theoretical and practical. Work in Laboratory, Junior and Senior years, under direction of the Professor of Chemistry.

7. *Geology and Mineralogy*, with special reference to Agriculture. The origin of soils, location of Artesian wells, etc.

8. *Military Science* and *Military Drill* continued through the whole course under direction of officers of the Regular Army, detailed by the United States Government for this special service. This includes weekly inspection of all halls and rooms in college buildings, thus securing neatness and proper sanitary conditions. The students of the college when graduated are competent, in their military knowledge, to receive commissions in the Regular Army.

9. *Mathematics* — Algebra, Geometry, Trigonometry and its application, Mechanics, Physics and Astronomy.

10. *English Literature, History, Constitution of the United States, Elocution, Essay Writing and Debates, Book-Keeping, Drawing.*

11. *Rural Law, Outlines of Mental and Moral Science.*

12. *French and German Languages.*

This is a brief outline of studies, without any attempt at systematic arrangement, as they are given in the curriculum of terms. Other subjects are introduced as circumstances favor. To some of the subjects here named, but little time can be given, and this varies with different classes; but to those studies, like Botany, Chemistry, Agriculture and Horticulture, which are the practical studies of the course, the time and strength of the student are specially given.

The course of study is so arranged that students may be absent from the college during the spring and summer, and yet go on with their classes. The studies of the first and second terms of each year make a connected course, or one which the student can complete by a moderate amount of study while absent in the summer. Students who complete this partial course receive certificates, but not the regular degree of Bachelor of Science.

In addition to the college proper, the work of which henceforth will be mainly that of instruction, the State has now established an experiment station which will give to the student a constant acquaintance with the methods and results of agricultural experimenting under the direction of the most competent men the board of control can employ.

The college can use to advantage larger funds than it has. In many directions, increased funds are absolutely essential for carrying out the true idea of the college.

The apparent income, as shown by the treasurer's report, is quite delusive. Several of the items generally given there represent the amount of business done by the farm and department of horticulture, rather than income for support of the institution. The net income is very small, while the work of instruction in practical science is very great, much greater than in an ordinary classical college that has no special scientific department. Small classes require the same amount of instruction as large ones.

The farm and department of horticulture are both subjected to large expense in the care of roads, grounds, plant-houses, etc., all of which must be kept in order for the credit of the institution, and as a means of instruction in practical work. This special care and ornamentative of grounds is provided for in most institutions by special funds. Here this expense, which is very large, is charged to the departments. They are thus made accountable for expense that does not properly belong to them. This gives their products an apparent cost which misrepresents the real state of the case. An attempt will be made to separate these items of expense, so that the real working of the farm and horticultural department shall be more clearly seen.

We feel the need of larger funds for every department of college work. We must look to private individuals as well as to the State for the aid the college must have to sustain and increase its efficiency, and make it second to none in the facilities it offers. While money is given so freely to educate men away from productive pursuits, it is certainly strange that in Massachusetts not a dollar has yet been given by private benevolence for the endowment of a chair of instruction in the Massachusetts Agricultural College, — an institution founded to fit men to become intelligent producers in time of peace, and efficient defenders of the State and Union in time of war. When all the legislators and citizens understand the true state of the case, we believe that the Massachusetts Agricultural College will never lack for students or the funds needful for carrying on this institution

founded by the joint action of the United States and the Commonwealth of Massachusetts.

EDUCATIONAL PLAN OF THE COLLEGE.

For the outline of studies and the special work in each department, we refer to the course of study, and the tabulated report of work in each department in the second part of this report.

It is the aim of the trustees to keep the requirements for entrance such that every boy in the State can find facilities for fitting himself for the college, without leaving his home, or incurring any expense for schooling which the well-ordered schools of the various towns cannot afford. If boys from fifteen to twenty years of age come with a good common-school education and give themselves heartily to the work here presented for them, they will, in four years' time, be well educated to begin any practical business of life.

The expense of education for four years is a serious matter for most farmers' sons. The other colleges have large funds for aiding indigent students, and a large proportion of those thus aided are as well able to pay their bills as the average farmer's son. It should be the aim of this college, then, to reduce as much as possible the college expenses, and to foster habits of economy among the students themselves. It now furnishes free scholarships, but it has no funds except a single scholarship to make good the loss of tuition. So that while the college diminishes the expense of the student, it diminishes its own power to do for him what ought to be done. Professors can do double work for a time, but there is a limit to their time and strength, and to their ability to properly teach so many subjects as are now required of them.

From necessity the college makes provision for the board of students, and it secures this at reduced cost by giving rent free the boarding-house and its furniture. The necessity for this provision arises from the fact that the college is so far removed from the thickly settled portion of the town that boarding places are difficult to be obtained within reasonable distance from the college grounds.

REPAIRS.

The legislature of 1882 granted to the college $4,000 for repairs. This money has been expended and the bills deposited with the treasurer of the State. The farm buildings have been repaired and painted; the laboratory repaired and painted, and provided with cases for proper protection of apparatus and specimens. The botanic museum has been painted outside and in. The lecture-room repaired and provided with cases for protection of specimens and instruments. The Durfee plant-house and propagating houses have been thoroughly repaired and painted. The heat and moisture in those houses had caused more serious damage than at first appeared. The farm-house now occupied by the market gardener has been shingled and otherwise repaired. The barns connected with this house have been remodelled and repaired for the use of the horticultural department, and the professor's house, to be occupied by Prof. Miles, has been repaired, painted and papered. All of these buildings from long neglect of repairs from want of means had become in many places unsightly and hardly fit for occupation. They are now essentially in good order, though much more might have been done to most of them with great profit, had the appropriation allowed. As is generally the case, the work proved more formidable than it appeared before it was begun. The carpenter in charge gave entire satisfaction, and we believe every dollar of the money has been judiciously expended. It would require at least $1,000 to complete the repairs upon the buildings, including the painting of the roofs which would be economy in the end.

It was supposed by the trustees that the Cowles buildings would be taken and repaired by the board of control of the experiment station. No estimate was therefore made for their repairs. If these buildings are not taken by the experiment station, they can be made of great service to the college for the assistant professor of agriculture. It will require $2,000 to put them in proper order for college use.

IMPROVEMENTS.

The unsightly gravel-pit near the road has been filled at large expense, and other important improvements have been made as indicated in the farm and horticultural reports.

Mr. Danforth K. Bangs has given to the college three-fourths of an acre of land at the intersection of the two roads that cross the college grounds from the south. This piece of land, rough, neglected and unsightly, was a great injury to the appearance of the college property. By this generous gift of Mr. Bangs, we have been able to transform this piece of land to a small ornamental park, so that the entrance to our grounds is now marked by the appearance of ornamentation and culture, instead of roughness and neglect.

The plan henceforth will be to concentrate the farm-work near the roads and farm buildings, and spend less money upon the pastures and swamps, till we have more to expend. Much of such labor gives very slow returns, and much of this kind of labor is still to be done on this farm. With so much land to be cared for by the work of students and by hired help, it is a very difficult problem to gain profit while trying to use the farm as a means of education. Much labor upon it has thus far been like labor in the laboratory, without any direct pecuniary profit. Now that the experiment station is to take the burden of experimenting, the farm-work should be narrowed to that limit that it can be done with profit. The position of the college, away from markets, renders the work more difficult for both the farm and garden than it would be were the institution near some large city affording a ready market for the most profitable crops.

Notwithstanding the improvements made, involving large expense, and the loss on nearly all crops in consequence of the unprecedented drought, the expenses of the college as a whole have been kept within its income. If we add to the reported balance $1,309,12, paid on debts of 1881, and $2,045.19, income delayed on account of change in securities, we should show a balance of $4,098.07, as the real condition of the college, January, 1883, as compared with January, 1882. It is estimated that the bills due the college will pay its present outstanding debts.

WANTS OF THE COLLEGE.

While we have set forth the capabilities of the college, we have not lost sight of what it urgently needs to increase its efficiency. Its library is not adequate for our purpose, — for the wants of the students. We have no proper library-room. There is no proper place for the cabinet, which is a valuable one for the purposes of instruction. It is the "State Collection," enlarged and enriched by private donations. During the past year it has received valuable additions of several thousand specimens of minerals, fossils, shells, insects and bird's eggs and nests, the entire private collection of Mr. Winfred A. Stearns, who presented it to the college, and personally superintended its classification and arrangement. Both this and the library are in dormitory buildings, with all their inconvenience for such purposes, and exposure to fire. We have no room suitable for public college exercises. The hall we now use for chapel is too small for any commencement exercise, and this room is needed to enlarge the chemical department.

One of our pressing needs, therefore, is a public building containing hall for public exercises, for the library and cabinet. We trust some public-spirited man will soon give funds for such a building. The names of the Hills, of Knowlton, and Durfee remind us of what has already been generously given to the college for specific purposes, and we feel that when the work and needs of the college are known, other names will be added to the list of our benefactors.

Our second need, perhaps first in importance, is a fund for payment of instructors. We should have more men, and they should be better paid. We must have men, the equals at least of those in other colleges, and they have more work to do than is ordinarily required of professors in classical colleges.

It was found to be impracticable to erect such a building as the college should have for the military department, for $5,000. The plans were cut down, but still no bid warranted the trustees in making a contract. They concluded to build by the day. The work has progressed far enough to show that a large saving has been made over the lowest contract

price. Still, the grant will not complete the building. It will be covered so that it can be used for drilling, but it will require from $1,000 to $1,500, to complete it for its whole work as drill-hall, armory, gymnasium and lecture room combined. The grant for repairs has been exhausted, and $1,500 is needed to complete those repairs, and put the old drill-hall in proper condition for a museum of agriculture.

It is hoped that the Cowles buildings may be found adapted to the wants of the experiment station, in which case those buildings will be repaired from the experiment station fund.

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